SENATE...... ......No. 20.

FOURTH ANNUAL REPORT

OF THE

STATE BOARD OF HEALTH

OF

MASSACHUSETTS.

JANUARY, 1873.

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MEMBERS OF THE BOARD.

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Commonwealth of Massachusetts.

STATE BOARD OF HEALTH, BOSTON, January 27, 1873.

Hon. GEORGE B. LORING, *President of the Senate of Massachusetts.*

SIR:—I have the honor to present to the legislature the Fourth Annual Report of the Massachusetts State Board of Health.

Very respectfully,

Your obedient servant,

GEORGE DERBY, M.D.,
Secretary of the State Board of Health.

GENERAL REPORT OF THE BOARD.

To the Honorable the Senate and House of Representatives of Massachusetts.

The State Board of Health herewith presents its Fourth Annual Report.

Small-Pox.

In our report of last year this subject, which has since become one of absorbing interest throughout the State, was considered at some length. In view of the epidemic then prevailing in Europe and also to some extent in Massachusetts, we thought it would be necessary not only to enforce the laws relating to vaccination, but to repeal the fifty-first section of the twenty-sixth chapter of the General Statutes, in order that cases of small-pox should be isolated. This absolute repeal was not accomplished, but the law was so modified as to give local boards of health much greater power for the removal of persons affected with the disease than they before possessed. Had the law remained as it was we cannot doubt that the destruction of life would have been even greater than has actually occurred.

We are now in the midst of an epidemic-influence of small-pox-poison more virulent than has been known for many generations. The evidence is abundant to show that both in Europe and America there is, for some reason entirely unknown, a readiness in the human body to receive both the virus of small-pox and the virus of the vaccine disease, such as no one now living has before seen.

There are records of such epidemics before the great discovery of Jenner, and they were truly terrible,—destroying from one-fifth to one-third of all who were seized, and this comprised the whole population except those who had been previously attacked, or had been inoculated with the small-pox virus.

The present epidemic is of such intensity that it is quite common for persons who have had small-pox in former years to now have it again. Such occurrences have been previously rare.

Vaccination, whether from the cow or from the human body "take" readily, and re-vaccinations prove abundantly the extraordinary susceptibility to the vaccine disease now prevailing, and *never before existing*.

In view of these facts, with which physicians and intelligent persons of whatever calling are now familiar, let us thank God for Jenner's great discovery, without which our homes would be desolated, and our peace and happiness destroyed. The imagination can hardly picture the horror which would to-day pervade Massachusetts were the present epidemic unchecked by vaccination.

We regard the law of the State authorizing town boards of health to remove persons affected with small-pox from their homes *only on certain conditions*, as unfortunate in its operation, and we think that it would have been better to repeal the 51st section, 26th chapter General Statutes without reservation, leaving it at the option of the local authorities to enforce the removal to a hospital, or to provide for the sick at their own homes, as might seem safest and best in each individual case.

From our correspondent at Worcester we learn the following facts in support of the opinion above expressed. " One man with modified small-pox was ordered to keep his room; but instead of doing so went to the college regatta. One of our most prominent business men would not stay in the house when he had a large crop of small-pox eruption, and insisted on going wherever he chose. A dentist having modified small-pox was told to keep his room and see no one; but instead of doing so, filled teeth in his office."

The special report on small-pox published in our third annual report, recommended that the law concerning vaccination be so modified as to require the primary vaccination of children within six months of birth. Three months would be still better. Under present circumstances a new-born child should be vaccinated without a week's delay.

The advice which has thus far been given by our Board with reference to small-pox has been as follows:

On the 10th of April, 1871, a circular was sent to the authorities of every city and town, warning them of the impending danger from small-pox, and urging the importance of immediate vaccination before the epidemic should get a footing within their boundaries.

Inquiries were then made from our medical correspondents all over the State, concerning the protection of the people by vaccination. Their replies, with other information on the general subject, were made the basis of a report on small-pox by our Secretary, presented to the legislature in January, 1872.

The Board at that time recommended the repeal of the fifty-first section of the twenty-sixth chapter General Statutes.

We would again urge upon the boards of health of cities and towns,—

1. To see that every person within their jurisdiction has the protection of recent vaccination.

2. To use all the powers which are permitted under General Statutes, *to isolate* every case of small-pox or varioloid which may occur.

3. To provide for the destruction of small-pox virus, under medical advice, in all infected clothing and premises.

Having done these things their whole duty as regards small-pox will have been performed.

The following order was adopted by the House of Representatives January 21st, 1873:—

Ordered, That the State Board of Health be requested to report to this House the number of towns and cities in the Commonwealth in which cases of small-pox have appeared during the years 1872 and 1873, the number of cases in each, the supposed cause of its appearance, and the whole number of cases at present in the Commonwealth.

In accordance with these instructions we have sent letters of inquiry to every city and town.

The replies will be communicated to the legislature as soon as received.

Miller's River Commission.

The Joint Commission, consisting of the Board of Harbor Commissioners of the Commonwealth, and the State Board

of Health, created by chapter 353 of the Acts of the year 1872, entitled, "An Act for the abatement of a nuisance in the Lower Basin of Miller's River, and for the preservation of health in the cities of Cambridge and Somerville," and charged by said Act with the duty of devising a plan of draining and abating a nuisance in a district in said Act described, bordering upon Miller's River in Cambridge and Somerville, and of reporting the same to the mayors and aldermen of said cities, entered upon their duties at once. The parties interested were heard, and the locality in question was visited and carefully examined.

The Commission then appointed an engineer to make original surveys of the territory, to ascertain the extent of water-shed, the source of the nuisance existing, and to report such plans as would meet the requirements of the Act. This duty was assigned to Mr. Phinehas Ball of Worcester, who accomplished his difficult work in a manner to not only satisfy the members of the Commission, but to win their hearty and unanimous approbation.

The recommendations of Mr. Ball were adopted, and a report based upon the plan he proposed was made to the mayors of the cities of Cambridge and Somerville on the 7th of December, 1872. It is understood that this report will appear in the Annual Report of the Harbor Commissioners, and it is therefore unnecessary to present it in this connection.

The following were the conclusions of the Miller's River Commission:—

"*First.* That the city of Cambridge complete its system of sewerage, so that such portion of its territory as is now drained into Miller's River be drained into sewers already made or projected, having their outlets into Charles River.

"*Second.* That the city of Somerville construct a main sewer, from Milk Street through Prospect, Washington and Cambridge Streets, into Tufts' Dock in Charlestown, on Mystic River, and connect with this main sewer, lateral sewers, in such a manner that whatever now drains into the Miller's River basins, will drain by this main sewer into the Mystic River, and that the city of Somerville obtain the requisite legislation to carry this main sewer through the territory of the city of Charlestown.

"*Third.* That the cities of Cambridge and Somerville fill up with clean gravel, to the grade authorized by law, all the channel, flats, and basins of Miller's River, lying east of Prospect Street in Somerville, and south-west of the Boston and Lowell Railroad; reserving at first from such filling, through the middle of said channel and basins to the outlet under the Boston and Lowell Railroad, a space not less than fifty feet in width, where such a width is possible, until the drainage of the territory of Cambridge and Somerville, now leading into these basins, has been diverted from them into Charles and Mystic Rivers, as herein before provided, and then in the months from November to April inclusive, finally removing from this reserved space the mud which has there accumulated in the process of filling the adjoining areas.

"*Fourth.* It will then remain to enforce those sanitary principles which the Commonwealth has already adopted with reference to industries of the class peculiar to this neighborhood.

"The Commission has adopted no temporary measures in regard to this nuisance, because it was conceded by the representatives of both cities, and of all other parties appearing before the Commission, that none could be devised that would give any substantial relief, and such was the unanimous opinion of the Commission."

It is hoped that this plan of abating a nuisance, which has so long affected the health, comfort and convenience of the occupants of the crowded territory around the Miller's River Basin, will be speedily carried into effect.

Sewerage of the Metropolitan District.

In connection with the investigation concerning Miller's River, and the practicable plan of sewerage reported by the Commission, we would respectfully invite the attention of the legislature to the need of some comprehensive and harmonious system for the drainage of the whole Metropolitan District. Cambridge and Somerville, in the difficulties they have encountered by the joint use of an insufficient outlet for their sewerage, may fairly represent other cities and towns in the immediate vicinity of Boston, whose trouble will come very soon from similar causes.

A competent engineer, surveying the whole territory without regard to the limitation of arbitrary lines representing the limit of jurisdiction of a single municipality, has, as we believe, solved a problem which might have vexed Cambridge

and Somerville for a generation. At the recent extra session of the legislature, an Act was passed providing for a commission of engineers to report plans for the sewerage and water supply of the Metropolitan District, but it failed from the non-concurrence of the city of Boston. It is hoped that some similar plan, free from the very reasonable objecttions which were made to the Act rejected by Boston, may be soon undertaken. It seems to us of great importance in the interest of public health that some comprehensive system should be adopted.

Revision and Codification of Health Laws.

We wish to call the attention of the legislature to the expediency of revising and simplifying the laws relating to public health. These laws are intended to give the boards of health of cities and towns authority to control every form of nuisance, to keep in check all contagious or infectious diseases, and to secure to every citizen the enjoyment of all those natural agencies whose purity can only be obtained by public authority.

To accomplish these objects the statutes have been frequently amended, and additions have been made. Some of these amendments and additions are very obscure in their meaning.

The State Board of Health is often applied to by the boards of health of cities and towns to know what is the exact measure of power they possess under certain circumstances, and for aid in the interpretation of certain statutes. In reply to such applications every aid is given which it is possible for our Board to supply. But we would respectfully suggest to the legislature that such interpretation of the meaning of the health laws is often difficult by reason of their complexity, and that it would greatly conduce to the efficiency of the local boards, and to the maintenance of public health, if these laws could be reduced to a form which any intelligent citizen could perfectly comprehend.

The Law concerning Slaughter-houses and Noxious and Offensive Trades.

Numerous complaints have been received by the Board during the past year concerning establishments liable to be

closed by the operation of this law. In every case, however, with the exception of one very recently brought to our notice, the party complained of, when visited by our Secretary, has expressed a willingness to do everything which the Board and the complainants thought necessary. Such concessions have satisfied all parties, and the complaints have been withdrawn. This disposition is in striking contrast with the experience of the Board in 1871, when "hearings" were necessary in nineteen cases, and many of them were very protracted, through the testimony of a great number of witnesses, and the elaborate arguments of counsel on both sides. It is very apparent that the readiness of parties maintaining nuisances of a character which makes them amenable to the State Board of Health, to do all which is needful to protect the health, comfort and convenience of their neighbors, is the direct result of the orders issued by our Board in the summer of 1871.

The Boards of Health of Cities and Towns in Massachusetts.

Very great powers to secure the public health and safety are given by the General Statutes to the local boards of health. By chapter 26, section 5, they are empowered to make such regulations *as they judge necessary*, and a penalty not exceeding one hundred dollars is affixed to the violation of any rules thus established. It only remains for the people to fill these offices with wise, discreet and fearless men.

If we could reach every citizen, we would counsel him to see to it that such men are selected as a special board to look after the interests of public health in every town of Massachusetts, at the coming March meetings. And we would say, moreover, that one member of every such board should be a physician. In our correspondence and intercourse with the cities and towns throughout the State, nothing is more evident than the need by the members of these boards of such special knowledge of the causes of disease as it is the business of a physician to be acquainted with.

The time has gone by when any physician could ignore the causes of disease, and prescribe only for the relief of present ailments. Medical books and periodicals are now full of interesting inquiries, whose object is to *prevent the occurrence of disease;* and this literature reflects the thought of the medical

world. Every town can have the benefit of this knowledge by availing itself of the services of an enlightened physician on its board of health. He will recognize the special dangers, unseen by others, because it is a part of his daily business to find them, and his faculties are quickened by use. He goes everywhere, sees the whole territory more frequently than any one, knows the character of the soil, of the water, and estimates the power for evil which the ignorance or slovenliness or cupidity of his townspeople suffer to exist about their dwellings in the form of putrescent materials. By his personal influence and advice the laws of health may become available for the use of every family. Nuisances may be reformed, air and water may be kept pure and wholesome, and an unceasing vigilance may be exercised to preserve, for the common good, the great essentials of health so that no one's bodily comfort shall be disturbed by such neglect as can be remedied by private advice or public authority. Much needless vexation may be also avoided by the employment of a medical man on a board of health, since he, better than any one, can discriminate between what is and what is not harmful to the public. There are now many towns in Massachusetts employing a physician on their board of health, and in every such instance which has come to our knowledge the great benefit has been apparent.

Butchers' Slaughtering and Melting Association.

Our report concerning the operations of this Association during the year, is one which we have great pleasure in making.

The abattoir, for whose construction we have labored ever since the formation of our Board in 1869, is nearly completed. That it is not yet in operation will not surprise those who may visit the establishment and see the magnitude of the undertaking.

A letter from the president of the association to our Board will be found to give the details of the work. That it will prove a sanitary success we feel well assured, and we also hope that it may be remunerative to its enterprising proprietors. The plans and all details of construction have

been approved as the law requires, and have been under the constant supervision of a committee of our Board.

We desire to call the attention of the legislature to the fact that no provision has yet been made for the inspection of animals and of meat. That such inspection is absolutely necessary to complete the benefits which the public will receive from the abattoir needs no argument.

Whoever buys meat from this slaughter-house must in some way be assured that the animal was in health when killed.

The fresh meat will be consumed for the most part within twenty miles of Boston, but the salted meats will be distributed far and wide.

We respectfully ask the legislature to provide for the appointment of an inspector of animals and of meat, at the abattoir of the "Butchers' Slaughtering and Melting Association" at Brighton, with an adequate salary, to be paid by the State, and that this inspector be under the control of this Board, since we are by the law made responsible for the safe and proper management of the establishment.

Special investigations have been made during the year, concerning many subjects having a direct influence on the maintenance of public health, and the results are printed in the accompanying documents. They are as follows:

Sewage and Sewerage; The Pollution of Streams; The Water-Supply of Towns.

A report in accordance with an order of the legislature. By WILLIAM RIPLEY NICHOLS and the SECRETARY OF THE BOARD.

The following order was adopted by the last legislature and transmitted to our Board on the tenth of April, 1872:—

"*Ordered.* That the board of health be requested to consider the general subject of the disposition of the sewage of towns and cities, having in view:

"*First.* Its utilization as a fertilizer.

"*Second.* The sanitary effects of draining the same into the waters of the Commonwealth.

"*Third.* The increasing joint use of water-courses for sewers, and as sources of supply for domestic use by the people of the Commonwealth.

"And that the said Board be requested to report to the next legislature their views, with such information as they can obtain upon the subject from our own or other lands."

The reply to the above order of the legislature is presented in a report prepared by Prof. William Ripley Nichols of the Institute of Technology and by the Secretary of our Board.

Prof. Nichols visited England during the summer, and gives the results of his observations.

The interest in these subjects in England at the present time is very great. There are also much partisanship and heated controversy in that country which tend to obscure the essential facts. Much capital is embarked in projects for utilizing sewage, and many English publications show its influence in unduly exalting their own special plans. Owners of patent rights magnify their value.

We in Massachusetts are so far removed from the strife that we should be the better able to form an intelligent judgment concerning some of these important questions.

The Board commend this report to the attention of legislators, officers of city and town government, and to all citizens.

The question of the utilization of sewage remains still unsettled. It is attended with great difficulties in all countries, but especially in our own, owing to the high price of labor, and to the dilution of sewage both from our profuse consumption of water, and the great annual rainfall, which is nearly double the annual rainfall of England.

Our reporters find little reason to expect good results from any purely chemical processes thus far proposed. Irrigation with sewage gives better promise. It would have to deal with frozen ground in Massachusetts for a portion of every year, but this trouble would not be met with in our Middle and Southern and a great part of our Western States.

We wish to call the attention of the legislature to the strong reasons given in this report, for the careful protection of our lakes and great ponds from defilement, since we believe the present and future health of the crowded cities and towns of Massachusetts, to be closely dependent upon the preservation of these reservoirs of pure water for domestic use.

Additional analysis of evidence as to the use and abuse of Intoxicating Liquors.

Beershops and Prohibitory Laws.

By Hon. P. Emory Aldrich, member of the Board.

We have much pleasure in presenting this paper which relates to evidence presented in:

1. Three printed documents sent to us by officials of the United States government in England.

2. A very voluminous and carefully prepared statement in manuscript from a gentleman holding an office under the Swedish government, giving an account of the use of intoxicating drinks in that country from the earliest times.*

3. A large number of letters from officials and private individuals, in this and other States, which have been very recently sent to our Board by a committee of the State Temperance Alliance of Massachusetts.

We present this paper by Mr. Aldrich, as we last year presented the paper by Dr. Bowditch, regarding both of them as valuable contributions to the discussion of the general subject of the use and abuse of intoxicating drinks, but without expressing, as a Board, any opinion concerning the inferences made by either writer.

On the character of substances used for flavoring articles of Food and Drink.

By Henry K. Oliver, M. D.

The Board recommend the careful perusal of this paper by every house-keeper and every parent. By it we learn that many articles, in common use as delicacies, are flavored with deleterious and even poisonous substances. We learn that the oil of almonds, used by confectioners, contains prussic acid, and that the almond extract, so much employed in domestic cookery, also contains this poison in a large amount; that almost all the candies, and many of the soda-syrups, bearing the names of the easily perishable fruits, as the

* Mr. Gyllenskiöld, our correspondent above referred to, sent also very elaborate statistical tables showing the enormous annual production of distilled spirits in Sweden. These tables were referred to the Chief of the Bureau of Statistics, Treasury Department, Washington. Their early publication by the Bureau in one of their monthly statements was promised, but they have not yet appeared.

strawberry, raspberry, banana, &c., &c., *have no trace of the fruit about them*, but are flavored by "fruit essences," which are deleterious etherial extracts, made in the chemical laboratory; that many of the fruit jellies in the market are made from apples, and flavored by the same artificial essences, to resemble the various fruits from which they are supposed to be made; that cheap wines, and other alcoholic liquors, are sometimes sophisticated by these essences and by other flavoring substances; and, finally, that tartaric acid is openly sold to be used as a substitute for fruit in pastry.

Drainage for Health.

By Hon. Henry F. French.

This is an eminently practical paper which will be of value in every country town.

The writer, Judge French, is already well known in connection with the general subject of which he treats. Excellent advice is given concerning the necessity of keeping wells free from surface and sewer drainage, and methods are proposed to gain these important ends. The plans are simple, efficient, inexpensive and easily executed by any intelligent man, aided by a very little mechanical skill.

Infant Mortality.

By Edward Jarvis, M. D.

This a most important subject. Dr. Jarvis deals with it with his wonted ability. The influence of food taken by the mother and her child, upon the latter's health and life is treated of. And in addition, the reader will find statements in reference to exposure to cold, and influences produced by hard labor, poverty, ignorance of sanitary laws, of fashion, and of civilization, &c., upon the mortality of infants.

The Food of the People.

By the Secretary of the Board.

This paper, founded on an extensive correspondence throughout the State, aims to let the people know the extent of their deviation from true methods in the providing and in the cooking of food. Significant reports come from various quarters of the State, in regard to evils, and of actual deaths,

resulting from either neglect or ignorance concerning this matter of food. Attention is drawn to the differences between the food of the mechanic and of the farmer, and of the gross imperfections of both. Dyspepsia seems very prevalent in some communities, owing to bad food and the inordinate use of tea and coffee. Wholesome bread is rare; its making is almost one of the lost arts, in some towns.

The results of "bolting" food, so common not only among railway travellers, but with large numbers of our people, are alluded to. One correspondent suggests the thought that, for the future health of our people, the art of cookery should be publicly taught: and another proposes that, by coöperative measures, comfortable dining-rooms for sewing-girls employed in cities should be established, where good substantial food could be got at moderate prices. Finally, one correspondent, a physician, writes that the people are sinning through ignorance; and that he is sure, from his own experience in the town where he then lived, much change had been introduced into the culinary department of many families by his persistent instructions given during the rounds of daily practice. The example of this young man, now, unhappily for his people, dead, is respectfully submitted to all physicians, in the full confidence that, if every one would in his own sphere, endeavor so to influence his neighbors, incalculable benefit would result.

The Adulteration of Milk.

A Report by Arthur H. Nichols, M.D., Assisted by Prof. James F. Babcock.

In this paper will be found the means of testing milk, and facts seeming to prove the almost universal sophistication of milk as delivered in Boston.

The writer calls attention to the present imperfections of the law with reference to this subject, which must be regarded by every one as of great importance.

Analysis of a Correspondence on some of the Causes of Consumption.

By the Chairman of the Board.

This paper is based on the analysis of a correspondence held with two hundred and ten physicians, resident in this

State and elsewhere. The letters are in answer to a circular issued by the Board. They come from intelligent men, all of them in constant practice, and their replies represent, in as far as this number can represent it, medical opinion on the various questions proposed. As such, the Board presents the analysis and extracts from the letters as a contribution to the discussion of the causes of this dreadful scourge of our State, —pulmonary consumption. At a future time the Board hopes for a continuation of the same subject; than which nothing can be more important, since consumption destroys in Massachusetts, about one-fifth of all who die.

Adulterations and Impurities of Food.

By H. B. Hill, Harvard University.

This investigation is in pursuance of a general plan which was commenced in 1871, and which we hope to continue.

In our third report Mr. Hill gave the results of his examinations of canned fruits, vinegar and coffee.

The present report deals with confectionery and pickles. By it we learn that lead, mercury, arsenic and copper are not infrequently found in the coloring matter of confectionery, and especially of sugar toys; and that the bright green color of pickles is an indication of copper.

The perusal of Mr. Hill's report is commended to mothers and house-keepers.

House Accommodation of the Poor in our most Populous Cities.

By F. W. Draper, M.D.

This is a most significant report by Dr. F. W. Draper, from personal inspection of the homes of the lowest poor in Boston, Fall River, Lawrence, Lowell, Salem, Lynn, Springfield and Worcester. It proves conclusively that the municipal authorities of every one of these places named have been neglectful in regard to carrying out the wishes of the legislature, as known by laws passed at various times. Lowell, owing to the recent epidemic, has been summoned to use those laws, and has acted upon them most efficiently in crushing out the small-pox. But evidences are now arising which show that the same laxity in regard to hygienic

measures which existed before the late panic, will ere long again prevail. In each and all of these cities, rookeries are to be found which are a disgrace to our civilization. It is interesting to observe, however, that in some places,—for example, in Lowell, Lawrence and Salem, where great corporations have erected large tenement-houses for their operatives, and have had them constructed and maintained upon hygienic principles,—the happiest results have followed. Due notice is taken by the writer, of those vile owners and lessees of tenements who prey upon the community by exacting exorbitant rents for places unfit for human occupancy.

The whole paper deserves a most careful study, not only by the municipal authorities of the cities reported upon, but by the selectmen, boards of health and inhabitants of every town. For it is evident that as similar causes exist in every large town, so similar evils are likely to be found throughout the State; and these evils, as far as possible, should be prevented by wise public law and by private effort. We have, in fact, among us, and rife, all the elements of the lowest barbarism, in which men and animals lie down together in filthy abodes. And, although this barbarism at present clings to a small portion of the community, it will be found to taint with its impurities a large area occupied by a better and more civilized class. It at times promotes a moral and physical pestilence and death.

Health of Towns.

This annual statement from our correspondents relates chiefly, in the present year, to the subjects of sewerage and water-supply in the largest towns.

It is our hope that the need of these most important means of improving the health of our rapidly growing cities and towns may be brought to the notice of the people of Massachusetts more prominently through the information contained in these letters, as well as by other papers in the present volume.

It will be seen that the mortality of Boston is unprecedented. Exclusive of deaths from small-pox, the mortality of 1872 exceeds that of 1871 twenty-five per cent. Includ-

ing small-pox the increase is thirty-seven per cent. Such results seem fully to justify all which has been said in previous reports of our Board concerning the culpable neglect of public health by the city authorities of Boston.

Public opinion has at last been thoroughly aroused, and has compelled the aldermen to relinquish a large share of the power which they could not wisely exercise, and has placed it in the hands of an independent board, from whom we have reason to expect the most salutary reforms. In all their efforts to reduce the mortality of Boston they will have the cordial coöperation of our Board.

It will be seen that *trichina disease* has occurred in Framingham. This is another warning against eating pork which is not *thoroughly cooked*.

The expenses of the Board have been a little more than usual, owing to the chemical investigations required to complete the report on sewage in accordance with an order of the legislature. It is hoped that the same appropriation for the Board may be made in 1873 as in the past year.

We desire to express our thanks to the registrars and city clerks of the most populous places in Massachusetts, for their politeness in furnishing the information which has enabled us to make a report of mortality in the "Boston Journal" every Wednesday morning.

All of which is respectfully submitted.

HENRY I. BOWDITCH,
WARREN SAWYER,
RICHARD FROTHINGHAM,
R. T. DAVIS,
GEORGE DERBY,
P. EMORY ALDRICH,
G. V. FOX,

Members of the State Board of Health of Massachusetts.

Expenses of State Board of Health, 1872.

Postage and stationery,		$450 92
Soldier Messengers,		78 93
Travelling expenses of Secretary,		118 44
Expresses,		67 93
Copying and indexing,		74 52
Carriages,		58 50
Printing,		37 85
Personal expenses of Members of the Board,		78 59
Chemical analyses,		662 12
H. F. Walling, for Report on Lakes and Ponds,		325 00
Paid for special investigations,—to	Wm. Ripley Nichols,	
	H. K. Oliver, Jr.,	
	H. F. French,	
	F. W. Draper,	1,894 35
	H. B. Hill,	
	Phinehas Ball,	
	A. H. Nichols,	
	Edward Jarvis,	
Miscellaneous expenses,		31 71
		$3,878 86

Sewerage; Sewage; The Pollution of Streams; The Water-Supply of Towns.

A REPORT

TO THE

State Board of Health of Massachusetts.

By WM. RIPLEY NICHOLS,
Professor of General Chemistry in the Massachusetts Institute of Technology,

AND

GEORGE DERBY, M. D.,
Secretary of the State Board of Health.

Sewerage; Sewage; The Pollution of Streams; The Water-Supply of Towns.

On the 6th of April, 1872, the State Board of Health was instructed by an order of the legislature, which will be found in the General Report on the tenth page of this volume, to collect information concerning sewage and the possibility of utilizing it, the pollution of streams and the water-supply of towns, and to make report at the next session.

These subjects concern every inhabitant of Massachusetts; they reach to the very foundations of national health and prosperity; and they are now most earnestly discussed in all civilized communities throughout the world.

They press with great force upon the people of this State at the present time. Our centres of manufacturing and commercial industry are growing with unexampled rapidity. Population is leaving the rural districts and crowding into the towns. Villages are transformed into compactly built cities in a single generation.

Some of the brooks which were but recently pure and undefiled are now polluted so that neither man nor beast will freely drink of them; and this change is insidiously taking place from year to year. The great importance of the subject was pointed out by the State Board of Health in their second annual report (1871). An examination was then made of the waters of Mystic Pond and of its sources both of supply and of defilement, and the results obtained were, in so far as that important source of drinking-water is concerned, a direct reply to the recent order of the legislature.

The utilization or "*beworthing*" of waste material of every sort is of equal interest to the political economist and to the sanitarian. To the one it is a direct saving of money; to the other a saving of health and of life, both of which have a true

money value. Fortunately these two great interests, as we believe, do really coincide.

They may sometimes appear to conflict, and with our present imperfect knowledge of the best methods of utilization they may even stand, for the time, in direct opposition to each other, but a way will be eventually found to bring them into harmonious relations. The waste of our Brighton slaughter-houses which polluted the air, at the same time increased the cost of furnishing meat for the markets. The utilization of this foul stuff is now seen to lead not only to health and comfort, but to profit also. And so it will eventually be with every form of waste organic material which so abounds where population is dense and industry is active.

We must never despair of success in the search for the means of converting our waste into useful and harmless products, however great may be the difficulties in the way.

Obstacles which now seem well-nigh insuperable may be expected to become less formidable and at last to disappear before the advance of science and of skill. It is no exaggeration to say that this problem of the conversion of the excremental waste of towns and people and the refuse of factories, into useful materials, is now engaging as much of the attention of intelligent minds throughout the world as any social question. The English press is burdened with publications on this general subject. Chemists, farmers, political economists, engineers, physicians and amateur sanitarians are all at work upon it. Towns and cities are making costly experiments to test the worth of all the various plans proposed. Stock companies are formed, whose business is first to make money for themselves at any rate, and secondly to benefit the rest of the world by their ventures. From all this excitement, which will eventually extend itself to our crowded districts, we ought to derive much useful information, and should be able, removed as we are from the heat of the controversy, to see things as they really are, and to estimate the various plans at their value. But while it is of great importance that we duly note whatever may be seen or known in foreign countries, it is still more essential that all facts bearing on these questions among ourselves should be carefully observed.

Our climate, soil, customs and social arrangements are our own, and unlike those of other countries. They require to be regarded by themselves.

It has been our endeavor during the past summer and autumn to collect as much information as possible concerning these points from all parts of the State, that thus a fair beginning might be made in the comprehension of the subject.

Let us first explain what is meant by the words "sewer," "sewerage" and "sewage," which will be constantly used. The two last are often confounded, but they signify quite different things. A *sewer* is an underground passage for the conveyance of water, human excrement, and fluid or half-fluid refuse emptied into it by the smaller drains from houses, factories and streets.

Sewerage is a system of sewers or subterranean conduits, and the word refers only to these works or constructions, while *sewage* is the material which is or may be conveyed in sewers.

Public health requires that the foul fluids, half-solids and solids resulting from human excretion, from the waste of food, from washing, and from the refuse of various manufactures should be either speedily removed from among the living, or that the character of these materials should be so changed that they will not undergo decay.

The urgent and instinctive need of absolute removal is felt by every one with regard to human excrement. We must be rid of it. There can be no safety otherwise. In the country, in isolated dwellings with plenty of ground about them, this purpose is accomplished by detached buildings from which the material may be readily removed and used as manure.

In compactly built towns and cities this method poisons the air, and if wells are used it renders themdangerous to all who drink from them, however clear, sparkling and inodorous the water may happen to be.

The Dry-earth System.

This method of disposing of human excrement has been a subject of general discussion of late, and its advantages and disadvantages should be fairly presented.

Abundant experience has shown that earth (not gravel or sand), when carefully dried so that it has lost all coherence or stickiness and has become a powder, possesses the power of absorbing and reducing to an inodorous form the excretions of the human body, provided it be immediately applied to them, and in amounts sufficient to cover them and to remove all fluidity of the resulting mixture.

The mass may be removed at convenient times and seasons and used immediately as a fertilizer for land, or it may be dried and used many times without giving off any offensive odor.

The dry ash of hard coal or anthracite may be also used instead of earth.

These are very important facts for everybody to know. Whether the action of the dry earth or ash be chemical or mechanical need not concern us; the effect is as we have stated.

It will be seen that the conditions under which the dry-earth plan can be used are exceedingly limited. In the first place the earth must be dried, and must be kept dry at all times for immediate use. This involves labor, and intelligent care and foresight. If the ash of anthracite coal be used the value of the product as a fertilizer is diminished.

In the second place, the artificial drying of either earth or coal ash for use a *second* time in private houses would be expensive, inconsistent with our social arrangements, and almost impracticable.

In the third place, no slops or sink-wash or any other fluids can be added without causing foul odors and making a nuisance, and from this it is seen that drains and sewers are still absolutely required, and that the dry-earth system cannot supplant them, but only relieve them of certain offensive contents.

In the fourth place, no one has yet shown that the foul odor is any measure of the danger from the retention of human excreta about our dwellings. It may be that while deprived of offensive smell these materials may yet, under certain circumstances, convey disease.

The difficulties which must attend the general use of the dry-earth plan in densely populated cities and towns seem to

us insuperable. If it is intended to absorb both the solid and fluid excretions of the human body (and the latter contain far more fertilizing material than the former), four or five pounds of dry earth must be supplied daily for each individual. Thus in a city of 100,000 people, 250 tons must be brought in every day from the surrounding country, and a somewhat larger amount carried out. And this must be divided among some 10,000 different houses, each of which must be carefully provided for.

With laborers' wages at $2 a day it will be seen that financially such operations are absolutely impracticable. The difficulty of enforcing care and cleanliness among the improvident classes makes such plans equally visionary in a sanitary point of view.

But the case is altogether different with country houses * having land about them from which the earth may be taken and to which it may be readily and profitably returned.

As regards houses in the country, there are also other and very weighty reasons for preferring the dry-earth plan. The wells may be protected from the fouling which they now so often get from human excrement, although their danger from drain and sink water is not in this way avoided.

The stench of the privy may be completely abolished. There can be no injury from frost, which is a much dreaded foe in our climate in all country houses furnished with water-closets.

In prisons and other large establishments where labor is abundant and cheap, the earth system may be applicable; possibly, also, in boarding-schools.

There can be no doubt that in country hotels and boarding-houses which are crowded with visitors in summer, the proper use of dry earth would remove a frequent source of discomfort and of danger. But here, as everywhere in New England, labor is dear. Guests are numerous and servants few. We have known several country boarding-houses where this method was professedly tried, but the earth was left exposed to wet, or was not systematically applied, and the result was a failure.

* See 2d Report of this Board (1871), pp. 235, 236.

In short, it may be said that the earth-plan is good and effectual, provided the conditions above stated are fulfilled, but these conditions are many and strict. It is a novelty, possessing claims upon the attention of every sanitarian, but like many other new things has perhaps been overrated. If it were in general use we could by no means do without drains and sewers, for the earth-plan cannot dispose of fluids except in very limited amounts.

Let us suppose that the dry-earth plan had been the only means of disposing of human excreta, as it is said to be in China, and that it was proposed as a new discovery that water should now be used instead. A reservoir being formed above, the water by a simple contrivance is turned on, and washes away through underground pipes all offensive things. Would it not be hailed as a blessing? Would not everybody rejoice in being rid of the continual annoyance of fetching and carrying, and in substituting therefor the force of gravity which is always ready to help us?

The disadvantages of the water-system are familiar to us from long use. The disadvantages of the earth-system, as applied to large communities are not so plainly seen because it has never been tried, while the advantages are, perhaps, overestimated through the novelty and (apparent) simplicity of the plan.

The Water-Carriage System.

The second systematic method of disposing of human excreta is by the underground drains and sewers which all compactly built towns are obliged to have in order to get rid of the surface-water falling as rain, and the liquid slops from washing and cooking, and also to a greater or less extent to relieve the soil of the superfluous water which it holds.

Drains and sewers have been in use for thousands of years, but it is only within the present century that they have been made carriers of excrement. Their use, however, for this purpose has increased of late in all civilized countries; and it seems probable that this will soon be the universal method employed in cities and crowded towns. We have already referred to some of its manifest advantages. The saving of labor is one which must specially commend it to all Ameri-

can communities. It is almost automatic in its operation. It sweeps away from our sight the most offensive things. It is capable of entirely relieving a city or town of the presence of such foul collections of putridity as are always disclosed in an ordinary privy vault. When a great fire destroys the houses and uncovers the earth in an old town, we can see how numerous and how vile are these places. Would not everybody desire to have such filth removed and the site of the town thoroughly aired and purified before the houses were rebuilt? By the water-closet system we are really enabled to keep the ground on which we live from being polluted by human excrement.

The water-closet system is, however, attended with special dangers which we should seek to avoid.

The Ventilation of House-drains.

By the use of water-closets and their attendant conveniences of fixed wash-bowls, bathing-tubs and sinks, the interiors of city houses are brought into close communication with the sewers. Whatever gases are contained in these underground passages seek not only to diffuse themselves under the law of nature with regard to gaseous bodies, but are also frequently subjected to severe pressure.

These gases are dangerous to health. What the specially noxious element in them is, no one can define. It is evidently neither carbonic acid, nor sulphuretted hydrogen, nor any other of the gases with which chemists are familiar in the laboratory. There is something beyond all this, coming from the decay of organized substances in a closed, pent-up position, without the free access of light and air, which at times gives rise to the most virulent poison, and to the most destructive forms of disease.

The sensible properties of sewer-air are quite remarkable. It is by no means fœtid, as many people suppose, neither is it pungent or ammoniacal. It is rather negative in character, faint in odor, mawkish, smelling, perhaps, more like soap than any other familiar substance.

Sewer-air may escape very freely in our dwellings, before its presence will be suspected, and that this happens very often there can be no sort of doubt. There are many reasons

for this belief. One cause for such escape, and a very active one, is found in the difference of temperature between the interiors of our houses and the interiors of the underground sewers. A rarefaction of air and an upward current are thus induced. The joinings of the soil-pipes are imperfect from alternate expansion and contraction by exposure to hot and cold water, and, unless a free and safe vent is provided above, there must be leakage at these points.

The air of the sewers is also subject to pressure from the sudden influx of water in rain-storms, and in sea-board towns from the action of the tide.

In Boston, all, or nearly all the outlets of the sewers are below the level of the sea at high water. As the tide rises, it displaces sewer-air, which is pressed inwards and must inevitably escape at some of the sewer inlets.

There can be no doubt that the rain-water conductors often serve the purpose of conveying safely away the imprisoned air thus seeking a vent,* an office not generally thought of in their construction. But their usefulness in this way depends upon their being left untrapped, which is not always the case. Frequently, instead of passing directly to the principal house-drain, without obstruction, they enter a water-sealed cesspool. But the rain-conductors, while sometimes acting as drain ventilators, are inoperative when the house gutters and pipes are filled with water in a heavy rain-storm. Neither do they relieve the pressure on the soil-pipes within the house, caused by expansion of the enclosed air by heat. We have then remaining only the water-traps of sinks, bath-tubs, wash-basins and water-closets, as a defence against the air of the sewers.

There is, however, another risk to which the health of the family is exposed through these contrivances, in addition to those which come from upward pressure, or from defective construction of the traps, or from unsoldering of their connections of iron and lead, or from their corrosion and decay by time and use. Whenever a large amount of fluid is thrown down the soil-pipe, whether from the bath-tub or any other opening, the tendency is to the formation of a

* This fact was noticed by Dr. Francis Minot, in the "Boston Medical and Surgical Journal," January 28, 1854.

vacuum behind it, and atmospheric pressure causes a suction upon every trap which is at a higher level. This may be shown, at any time, by pouring down a bucketful of water and observing the commotion which ensues in all the traps above it. It not unfrequently happens that the water of the trap is, in this way, sucked or "syphoned" out, and the pipe consequently remains open to the sewer, and the trap empty, until filled again by the next use of the water.

There is also an obvious escape of the air of the soil-pipe, corresponding with its constant daily use. Whenever fluids are introduced a certain amount of air is displaced and must go somewhere. Unless other vent is provided, it flows directly upwards.

For all these reasons we would advise giving the whole drainage plan of a dwelling the freest possible communication with the outer air at a point so elevated that the sewer gases cannot fail to be diffused and got rid of. This can readily be done, while building, by carrying the soil-pipe, made of iron, at full size, through the roof, and leaving it open like a chimney. By this arrangement all stagnation is prevented; the contents of the house-drains are constantly exposed to the oxidizing and purifying influence of currents of air; when rain-conductors are filled with water there is still free escape for the sewer-gases; and the water-traps throughout the house are relieved from pressure, both of the pent-up sewer-air on the one side, and of suction, or atmospheric pressure, on the other. In houses already built a lead-pipe may be readily carried from the highest point of the soil-pipe directly through the roof; but the larger the pipe, and the straighter its course the better.

In one instance, at least, where this plan has been adopted, a constant current is found to flow outwards, through the pipe.

Sewage from other Sources.

There are other forms of refuse, of a fluid or semi-fluid kind, which may be carried away by force of gravity in sewers. The washings and scrapings of hides, both their outer and inner surfaces; the washings of hogs, after scalding their skins as is practised at hog slaughter-houses; the wash of all slaughter-houses, and of stables; chemicals used in the prep-

aration of leather and morocco; chemicals used in woollen and cotton factories and print works; the fluid waste of rendering establishments and of soap factories,—these are among the most important of this class. But we must add the liquid waste of manufacturing establishments of every description, and to these are joined, in all compactly built towns covered with buildings and paved or macadamized streets, the whole rainfall of the district, amounting to about one hundred tons per acre for every inch of rain.

Other forms of Refuse not Removable by Sewers.

Swill.—Another form of refuse with which we have to deal is the waste of food known as "swill," consisting mainly of bones, meat, farinaceous food in various forms, and vegetables. Sewers cannot be used for getting rid of this stuff. It is too solid, too bulky (far greater than a true economy should allow in most families in New England), and is generally utilized in our towns by methods to which we shall again have occasion to refer.

Ashes.—Still another form of refuse which sewers cannot remove is the ash of various forms of fuel.

Let us now see how all these various kinds of refuse are disposed of at the present time in Massachusetts. A series of questions relating to this among other matters, was addressed to our correspondents in sixty-nine cities and towns of the State, being all which contained four thousand or more inhabitants; we have returns from every city and town. The inquiries under this special head of the disposal of refuse materials were as follows:—

Refuse Materials.—*Solid, Half-Solid and Fluid.*

What is done with ashes?

What is done with meat and vegetable refuse, or swill?

Sewage.

(Including under this term all refuse which may be carried away by sewers.)

What disposition is made of human excrement?

Of fluid slops? including chamber urine?—Kitchen or sink-wash? Soap-suds?

What disposition is made of manufacturers' sewage?

Ashes.

The information received shows that wood ashes are universally used either for making soap, or as fertilizers.

Coal ashes are in rare instances mixed with manure and spread upon land. They are also sometimes, and in small amounts, thrown into privies. But the almost universal use to which they are put is to fill up low and wet grounds, sidewalks and streets.

In the smaller towns, with detached dwellings, they are piled up during the winter quite near the house, often mixed to a greater or less extent with refuse liable to decay, and with too frequent disregard to the proximity of the well; and in the spring are taken away for the uses above mentioned.

In the largest cities provision is made by public authority for the systematic removal of ashes, but in by far the larger number of places, each householder does the best he can with them on his own account.

Meat and Vegetable Refuse.

Meat and vegetable refuse is disposed of in various ways.

The larger bones and the trimmings of meat at markets and provision stores go to the bone-boilers. Near each of our largest towns may be found one or more establishments where the fat of these materials is extracted, and the scrap or tankings either given directly to hogs, or pressed into cakes to be sold for hog or poultry food.

The larger bones are usually reserved, and after being dried, are sold to be made into animal charcoal, or pulverized for use as a fertilizer. The bone-boilers also generally receive dead horses and cattle, to be utilized in the same way. Some of the bone-boilers send their teams great distances, and collect uncooked bones and meat from all the surrounding country.

The meat and vegetable refuse of the household, known as "swill," is generally utilized as food for swine. It is no easy task for the health authorities of any town to regulate the decent distribution of this sour and offensive stuff. In most cases it is done in a slovenly and very unsatisfactory way. Some of our largest cities collect it twice a week by author-

ized scavengers and deposit it in neighboring towns where it is either given directly to hogs, or sold to the swine keepers of the surrounding country. In either case a nuisance is the consequence, and sometimes these depots for swill are so offensive as to prevent the improvement of the adjacent lands. In other populous cities and very many large towns, the citizens dispose of this refuse from their houses, by giving it to the children of Irish swine-keepers, who collect it in pails and wheelbarrows, and slop it about the premises.

This is allowed by the health authorities of cities like Springfield, Salem, Lynn, Fall River, Lawrence and Holyoke.

In Fall River the mixture of swill with ashes is also permitted. This practice (a very common one out of New England, but a very uncommon one in Massachusetts) has some sanitary advantages. In hot weather the sour decay of vegetables may be thus rendered less offensive, and perhaps also less dangerous. But it happens that at the season when a large supply of ashes is needed to cover up the swill, only a small amount can be had from the kitchen fire. This mixture is indeed an imperfect application of the "dry-earth system" to the solid refuse of the kitchen.

A great sanitary disadvantage must also be recognized when ashes, polluted by swill, are used for filling land on which dwellings may be subsequently built.

In the smaller towns every household is left to its own resources, and swill is generally thrown into the family pig-pen, or is given as food to cattle, poultry, dogs and cats. It is often cast into the privy, or the barn manure-heap; sometimes into the kitchen drain (blocking it up in time), and among very careless and slovenly people it is thrown out upon the surface of the ground.

Sewage.

In the inquiries made of our correspondents, sewage was subdivided, but in the replies this distinction was not always preserved, and the information thus collected will be the better understood if we sometimes class together all the various forms of fluid or semi-fluid waste which sewers are fitted to convey.

It is to be remembered, however, that human excrement is by far the most important of sewer contents, whether regarded from a sanitary or economical point of view.

All the cities and towns may be classified thus :—

1. Those which have good, or complete sewers.

2. Those which have sewers more or less complete, or in process of construction.

3. Those which have no sewers.

The water-supply in each case will be reviewed in another part of this Report, but it will be now seen to have a close connection with the sewerage. The two systems are intimately joined. When people are massed together in crowded towns, the local supplies of water inevitably fail, and it must be finally brought to them from without, and having been so brought and used, it must then be carried away again. Sewers thus become a necessity.

The only cities in Massachusetts now provided with a system of sewerage which can be regarded as approaching completeness, are Boston and Worcester. In Boston it has grown out of the absolute necessities of a very crowded population. Some of the sewers date from a very early period in the city's history, and were originally provided to drain the springs, and thus followed the line of old water-courses to the harbor. Additions have been made at all subsequent periods, until there are now one hundred and twenty miles of sewers. The filling up of very large tracts redeemed from the sea on all sides of the city has seriously complicated the system of sewerage. More than half of Boston is thus elevated but little above high-water mark, and the grade of the sewers is correspondingly unsatisfactory. We regret to say that authority to erect buildings has been given of late years very freely in sections which cannot be properly sewered, and which must subsequently be raised at enormous cost.

Of the various forms of matter included under the head of sewage it is estimated that in Boston about one-half of the whole amount of human excrement is now carried away by sewers, and the other half (5,000 cords per annum) is deposited in vaults and subsequently removed in carts by night, to the neighboring country. Of the other constituents of sewage very much more than half is swept away by the sewers.

It seems also very certain that in addition to the 5,000 cords of excrement removed by hand labor, a great deal of the fluid portion sinks into the earth through imperfectly constructed vaults and cesspools, and finally reaches the harbor either through the sewers, which, however built, drain the soil to a certain extent, or by direct passage.

Worcester has recently adopted a system of sewerage, and has had the great advantage of being but little hampered by previous constructions. These works are on a very complete scale, and are a subject of just pride to the city and Commonwealth. If their cost has been great their advantages on the score of health, comfort and convenience will be in corresponding measure, and they will benefit that prosperous city in all coming time. These sewers may be reasonably expected at an early day to convey without the city in a safe and convenient manner its whole fluid and semi-fluid refuse. They are already very extensively used.

Lynn, Fitchburg, Lowell and Holyoke are following Worcester in establishing a complete system of sewerage. Medford is discussing the question, and has recently employed an engineer to report a plan.

Taunton, Salem, Danvers, Milford, Brookline, Haverhill, Springfield, Somerville, Pittsfield, New Bedford, Middleborough, Lawrence, Grafton, Fall River, Chicopee, Charlestown, Cambridge and Amesbury are partially provided with sewers at public cost, which are capable of removing fluid and semi-fluid waste. In other places natural water-courses running through the roads and streets, are, to a certain extent used under public authority to convey away this refuse, and in very many others the streams on whose banks towns have grown up, have private drains leading from factories and dwellings, into which sewage is conducted.

There are many large and thriving towns in which the citizens are following the old traditions with regard to the removal of refuse, without as yet comprehending the new requirements which their growth has gradually brought about. They are without sewers, and their sewage is left to be a source of offence and of danger to public health. Among them may be mentioned North Adams, Hyde Park, Hopkinton, Gloucester, Northampton, Woburn, Dedham, West Roxbury,

Hingham, Marblehead, Stoneham, Randolph, Webster, Ware, Watertown, Waltham, Wakefield, Stoughton, Rockport, Quincy, Peabody, Newton, Natick, Great Barrington, Clinton; Blackstone, Beverly, Barnstable, Attleborough, Amherst and Abington.

There are some cities and towns in which the water-supply is abundant, and the sewerage deficient. Excellent water is brought to every house, but no adequate provision made for carrying it away after it has served its purpose. The benefit of the large supply is thus greatly qualified, and in low and damp places it becomes a real disadvantage. The water and fluid waste are, in such cases, spilled upon the ground, or in case water-closets are used, the contents are led into cesspools * in gardens or back yards.

Excepting the houses directly connected with sewers, and the houses provided with cesspools connected with water-closets, as above referred to, and the houses provided with a stated supply of dry earth or ashes, and the means of applying them, the same general remarks will apply to the whole population, in speaking of the prevailing modes of disposing of human excrement, and the fluid waste of the kitchen and household, and the fluid waste of manufacturing establishments.

In the vast majority of households in Massachusetts, human excrement is deposited under small buildings, either entirely detached from the dwelling or connected by a wood-shed or other covered passage-way. These buildings (privies) may have a brick vault or may merely cover a hole dug in the earth. In either case, unless unusual care is taken in the construction, the liquid portions, in which are contained four-fifths of all the value as manure, soak into the ground. From beneath these buildings the solid contents are removed from time to time, and put directly on the land as a fertilizer, or mixed with loam, or barn-manure, or ashes, before being so applied.

* This word *cesspool* really signifies not only a pit for the deposit of insoluble matters, as stones, sand and solid refuse, which may get into drains and sewers, but also an arrangement by which the passage of air may be prevented—as seen in its simplest and perhaps best form, by making the outlet at a higher level than the inlet. The word is, however, generally applied in Massachusetts, to any enclosed pit, whether in a line of drainage, or at its terminus, and whether trapped or otherwise.

This plan of privies with vaults has much to recommend it in a sanitary view, provided the premises are kept clean, and the product is not allowed to accumulate in great amounts, or is systematically covered with dry earth or ashes; but it is attended with special dangers also. If not looked after by careful and intelligent persons, a privy becomes an offence to its neighborhood, both above and below ground. It infects both the air and the earth. It may readily poison the air which the family must breathe, and the water which they must drink. A neglected privy in the neighborhood of a well, or any privy within thirty or forty feet of a well in soils of ordinary porosity, will affect the purity of the water, as may be seen by careful analysis at any time, and as may be demonstrated when least expected, by fevers, dysenteries and intestinal disorders.

There is great need of vigilance on the part of town boards of health concerning this condition of privies. Physicians know very well the danger, but often find it hard to convince their fellow-citizens. In the boarding-houses of the smaller woollen and cotton mills, all over the State, the foul state of these privies calls for special notice.

In the boarding-houses of the larger establishments, more care is used. In boarding-houses occupied in the summer months by visitors from cities and crowded towns, the offence to which we have referred is a frequent cause of illness.

House vaults in the larger towns are emptied by public authority; the householder notifying the board of health and paying a certain sum for each load removed.* This is generally done by night and in the colder season of the year, but neither of these restrictions are observed in all the towns.

In the smaller towns it is a common practice to sacrifice the value of human excrement as manure, and bury it by the side of the privy in deep holes dug for the purpose.

* It would be conducive to public health in our cities and large towns if all privies were emptied at public cost, as well as by authorized persons. The householder is now tempted to let their contents accumulate until they overflow, or the walls break away, thus endangering the health of the whole neighborhood. Or, perhaps a more equitable and equally safe arrangement would be, to have every privy vault inspected at certain intervals by authorized persons, who should decide when it should be emptied and when it should be repaired, both operations being at the householder's expense.

In the open country it is universally applied as manure to the soil, in some of the forms above mentioned.

As regards the other chief constituents of sewage, viz.: 1, chamber urine; 2, kitchen and sink wash; 3, soap-suds, —they go into sewers wherever sewers exist. Under other circumstances, among decent people, the first-named goes to the privy vault. The expedients resorted to for the sake of being rid of the other two are many and various. Sometimes a drain from the kitchen conducts these fluids into a pit (generally called a cesspool), from which they either soak into the earth, or are in part preserved for watering the neighboring plants. Occasionally we may find two pits, one to receive the contents of the water-closets, and the other for kitchen wash. Sometimes the latter is carried to the barn manure-heap. A hogshead sunk in the earth often forms the pit for kitchen wash. Frequently, however, all these slops are thrown on the ground at the backdoor. In a great majority of country dwellings, a short spout may be seen projecting from the rear wall, out of which flows all the fluid waste of the kitchen. This is frequently conducted by an imperfect drain of wood or flat stones to some neighboring depression in the ground, or to the highway, or it is left to soak into the earth by the side of the house. The latter is too often the case. In many instances, this constant dropping on a limited space has gradually made an underground direct passage to the family well, which drains the whole vicinity. One of the best ways to dispose of these slops in isolated dwellings, where the conformation of the ground permits, is to conduct them by a tile-drain to a point a hundred feet from either the house or the well, and to plant grape-vines about the outlet.

Sewers.

These constructions play a most important part in the preservation of public health. Hidden, and consequently but little thought of, they are, in crowded cities, our constant and faithful servants, removing from among our dwellings, yards and streets, not only the superfluous rain, but every fluid and semi-fluid form of refuse matter, which if allowed

to accumulate, would pollute the air and cause pestilence, as it did in European cities centuries ago.

A system of sewerage receives its fluid contributions from every house, and conveys them to a remote and safe place of deposit by channels of constantly increasing size. It is the reverse of the plan of water distribution, when the supply is from a distant point. Both systems are represented by a tree and its branches, and both depend on gravity for the motive power.

Sewers may be used, 1st, for the exclusive removal of excremental and waste fluids; 2d, for the removal of rainfall; 3d, for the removal of superfluous water in the soil.

There are those who strongly advocate the separation of the first two from each other. "The rainfall to the river, the sewage to the soil" is an alliterative saying which has had great currency in England. It however, involves the construction of a complete double set of sewers in every case, and it sacrifices the advantage of occasional flushing and complete washing out of these conduits by violent rainstorms. Our best engineers do not advise this separation, except to provide "storm water overflows" as a measure of economy. With such outlets, a system of sewers may be made of less capacity, and at less cost.

The question of the expediency of uniting the first and second uses with the third, is one not readily answered in theory, and in practice is attended with great difficulty, whichever may be considered the better plan.

There can be no doubt whatever about the great sanitary advantage of thoroughly draining the soil on which we live. It is also very important that the contents of sewers should not leak into the soil through which they pass. These conditions are both theoretically fulfilled, when the grade of the territory permits, by having a double system of conduits, one placed above the other: a drain-pipe of pervious structure, like that described in another article of this volume on the drainage of country dwellings, being laid directly beneath a sewer built of materials absolutely impervious to water.

Practically, however, sewers drain the soil to a greater or less extent. It is exceedingly difficult to prevent this effect, whether the sewer be of wood, brick laid in cement, or even

vitrified drain-pipe. The water enters at the joints, if nowhere else. And, on the other hand, when sewers are full, —as for instance, at high tide in Boston,—there is a corresponding leakage outwards. No absolute rule can be laid down which will suit all cases and all grades. It is a question of engineering practicability and of sanitary advantage. No doubt a system of sewers built of iron and jointed, like the water-mains of our great cities, might exclude the soil-water, and might be underlaid by drain-pipe, but even when practicable, the enormous cost of such constructions puts them out of the reach of our towns.

The best we can reasonably hope for is that the centres of population and active industry in Massachusetts shall be furnished with sewers, arranged by competent engineers on a complete system, capable of indefinite extension as population extends, and that these sewers be built of brick or of glazed drain-pipe, either of which will last for generations.

Sewers now in use in Massachusetts.

Each of the sixty-nine towns containing four thousand inhabitants has sent a reply to the following questions :—

Where a system of sewerage exists in the whole or part of a city or town, please describe it, in so far at least as to show whether the sewers are—

Of brick.
stone-masonry.
cement.
wood.
iron.
Scotch drain-pipe.
other forms of earthenware or pottery.
flat stones.

As we have before stated there are very few cities in Massachusetts provided with a system of sewerage which can be regarded as satisfactory; completeness in this respect can hardly be expected in cities growing with great rapidity. Worcester must certainly head the list with a comprehensive arrangement of sewers built, after a well-devised plan, of stone-masonry, brick and cement-pipe.

Boston is provided in different parts of its now large territory with sewers of many kinds. Sewers, when carefully built, are very durable constructions and require few repairs.

Many of those in Boston date from an early period in the town's history, and still do good and faithful service. There are five miles of stone-masonry, sixty-seven miles of brick-work, two miles of cement-pipe, fifteen miles of wood submerged at high-water, ten miles of Scotch pipe, one mile of other earthen pipe, and twenty miles built with dry-brick sides, covered with slate.

Sewers now in course of construction at Holyoke are chiefly of brick. At Lynn, twenty-one thousand feet of sewers are of brick and eight thousand feet of Scotch drain-pipe.

In the other sewered towns we find in recent constructions the same enduring and trustworthy materials used as at Worcester, Holyoke and Lynn. Cement pipe is also extensively employed, and is approved by engineers of repute.

In the oldest towns, sewers of *flat stones* are still in use to some extent, and in many towns which have not kept up with the advance of knowledge in this direction they have even been built of late years. Nothing in the shape of a drain, or purporting to do the office of a sewer or drain, can be more unsatisfactory. They fail in every way. The dirt and rubbish lodges in their angles and obstructs them. Water passes in and passes out with perfect freedom in their best condition. There can be no excuse for making such conduits for liquid waste in the future, when vitrified pipe and cement pipe are to be had at moderate prices.

Outlets of Sewers in Massachusetts.

Where are the contents of sewers discharged? This question is readily answered. We know of but two directions which are taken by the sewage of all our cities and towns. It is discharged either directly into the ocean or *into the nearest water-course.* Whether these water-courses be brooks already notoriously foul, or streams from which no one will drink, like the Blackstone and Neponset Rivers, or others in gradual process of spoiling, like the Nashua and Housatonic, or rivers like the Charles, on whose banks preparations are now making for the supply of drinking-water to large towns, or great rivers like the Connecticut and Merrimack—it makes no difference—the liquid refuse of all living on their banks is added to the stream.

In a sanitary view of the question we believe that *in the present state of human knowledge and experience*, no better receptacle than the ocean can be found, provided the sewage is delivered where deep currents can disperse it so that it shall be no more seen, and can prevent its deposit in the settling-basins of docks and the mud-flats of estuaries.

Streams are practically used as sewers, not only in Massachusetts but everywhere else, except in the face of the most stringent regulations and a police vigilance such as can only exist under a government of despotic power.

The temptation to cast into the moving water every form of portable refuse and filth, to be borne out of sight, is too great to be resisted. It is felt as strongly by municipalities as by individuals. What becomes of this refuse lower down the stream is a matter of little concern. It is got rid of at any rate, and those who thus dispose of it, if they think at all about its final destination, hope that the stream will purify it in some way, so that it will be no longer a nuisance and offence. Wherever a constant stream of water flows past a dwelling, or a collection of dwellings, or a factory of any description, it receives contributions of this kind.

It will be seen in another part of this Report what effect such additions of decaying materials must have upon the purity of the waters into which they are thrown, to what degree a running stream is capable of clearing itself from contamination, and the probability of even our largest rivers ultimately becoming sewers unless some practicable means be found of diverting this filth from their currents.

On the Treatment of Sewage.

Having already shown that, as a rule, the best method of getting rid of excretal and other refuse matters is by means of the water-carriage system, the question arises,—what shall be done with the sewage? The problem presents itself in two aspects; first, from the sanitary point of view,—how shall this matter, ready to putrefy, be got out of the way without injurious effects upon the community? second, from the economical point of view,—can the valuable fertilizing ingredients of the sewage be turned to account without an outlay greater than the return?

That so large an amount of excretal matter as finds its way into the sewers, especially where an abundant water-supply has led to the general adoption of water-closets, should go to waste seems at first sight to be a manifest absurdity, but if its recovery involves an expenditure greater than the value of the material recovered, then the true economy is found in the apparent waste. Thus there are portions of many articles, both of necessity and of luxury, which are daily cast away by common consent. Their intrinsic value in the aggregate is very great, but the cost of the labor involved in combining and utilizing them would be still greater.

It may, however, be necessary in the interest of the health of the community, that some process of treatment should be devised by which sewage should be rendered innocuous; if at the same time this process may be made to return a part or the whole of the outlay involved, so much the better.

Approaching the investigation of this subject without prejudice, in the light of the experiments carried on in England, and comparing the condition of things there with those which now exist in this country, we have been led to the conclusion that it is possible to purify the sewage, so that it may be discharged into running streams without rendering them a nuisance; without making the water too impure for use in manufacturing operations; without killing or driving away the fish which may inhabit them;—in short, without materially injuring them for any purpose, except as sources of water-supply for cities or towns. We are led also to the conclusion that no process of *utilizing* sewage has yet been proposed by which, unless in exceptional cases, its purification can be made a source of real profit, although the purification may be so conducted that there shall be some pecuniary return.

In giving the reasons which have led us to these conclusions, we propose first to describe, as briefly as possible, some of the many processes which have from time to time been proposed; we shall consider the results of the practical experiments which have been carried on in England, where the subject of the treatment and utilization of sewage has for a long time occupied the thoughts of chemists, agriculturists and engineers. We then propose to present the results of a number of analyses of the sewage from two of the largest

cities in Massachusetts, and to show how far the processes which have proved satisfactory in England, will bear application to the altered conditions of climate and other circumstances here.

Our information with regard to the investigation of the subject in England, is derived mainly from the published reports of the commissioners appointed by Parliament in 1865, "to inquire into the best means of preventing the pollution of rivers;" from the reports of a second commission appointed in 1868; from the reports of the British Association Committee on the treatment and utilization of sewage; from Dr. Corfield's most excellent work on the same subject; and from a variety of pamphlets to which the very general discussion of the subject has given rise. Morever, one of the authors of this report, during a few weeks' stay in England the past summer, had opportunity for conversation with many of the authorities on the subject, and to visit some of the localities where processes of purification or utilization are carried on.

In the first place, what is the nature, the chemical character of the liquid with which we have to deal? Sewage is a very complex liquid, consisting not only of human excreta dissolved or diffused in water, but also of water rendered impure by a great variety of substances, such as the soap-suds and other refuse from the kitchen and laundry, and in many cases the drainage from manufacturing establishments. The chemical character of the English sewage may be best seen by an inspection of Table I, where are collected some analyses selected from a great number made by the Rivers Pollution Commission.* To determine the average composition of sewage with anything like exactness is quite difficult on account of the very great difference in its composition at different hours of the day and night. The average composition employed by the commissioners for purposes of comparison is given in the table as well as the maximum and minimum results obtained in the examination of the samples from which the averages were made up. The results are stated in parts per 100,000.

* First Report of the Commissioners appointed in 1868, to inquire into the best means of preventing the pollution of rivers. (Mersey and Ribble Basins.) Vol. I. Report and Plans. London, 1870.

TABLE I.—*Composition of English Sewage.* (Results of Analyses expressed in Parts per 100,000.)

DESCRIPTION.	Total Solid Matters in Solution.	Organic Carbon.	Organic Nitrogen.	Ammonia.	Nitrogen as Nitrites and Nitrates.	Total Combined Nitrogen.	Chlorine.	Suspended Matters.		
								Mineral.	Organic.	Total.
Average of 50 samples of sewage from 16 water-closet towns, ...	72.2	4.696	2.205	6.703	0.003	7.728	10.66	24.18	20.51	44.69
Maximum,*	117.8	16.335	4.977	25.960	0.076	24.325	21.50	182.80	56.28	234.16
Minimum,*	41.2	1.104	0.680	2.030	0.000	2.371	4.00	0.84	3.36	4.94
Average of 37 samples from 15 midden towns, ...	82.4	4.181	1.975	5.435	0.000	6.451	11.54	17.81	21.30	39.11
Maximum,*	419.6	11.012	7.634	30.350	0.000	30.638	21.50	79.68	52.12	131.80
Minimum,*	31.1	1.288	0.357	0.380	0.000	1.592	6.50	4.14	4.46	8.60
Average composition of sewage. Standard taken by Commissioners, . .	64.5	4.386	2.484	5.557	0.000	7.060	10.4	–	–	–
Average Norwood sewage, 1868–69, .	94.9	3.972	1.586	6.032	0.000	6.554	8.66	–	–	–
Average Croydon sewage, 1868–99, .	45.7	2.508	1.051	3.006	0.000	3.527	4.23	–	–	–

* These figures do not, of course, represent the composition of any one sample.

Value of the Sewage.—There are several ways of estimating the value of sewage with more or less accuracy. In the first place, knowing, from numerous analyses, the composition and average daily quantity of the fæces and urine of one person, we can calculate from the number of inhabitants the average quantity of fertilizing material which would naturally find its way to the sewers of a town provided with a complete sewerage system; or the value of the sewage may be calculated from the examination of a large number of samples taken under a great variety of conditions and at all hours of the day and week. By the first method of computation no account is taken of other than human excrementitious matters, but as these form by far the largest amount of useful matter in the sewage, the results obtained are sufficiently accurate. Moreover, it is to be considered that, although the value of the fertilizing ingredients of a certain amount of sewage might in the dry state be worth a certain sum, yet this value may be very sensibly diminished when the material is diluted with the large amount of water by which it is accompanied.

The value of the annual voidings of an average individual of a mixed population of all ages and both sexes is variously estimated at from 6*s*. 8*d*. ($1.61) to 8*s*. 4*d*. ($2.01). The value assigned to "average" sewage by the Rivers Pollution Commission is 17*s*. ($4.10) per 100 tons (2,240 lbs.) or about 2*d*. (4 cts.) per ton. Although the amount seems small when we consider the value of the excreta of a single individual or the value of a single ton of sewage, yet when we reckon the entire annual amount of the sewage of a large town, we find that the total money value is very great. For instance, the sewage of London has been estimated to amount to 260,000,000 tons annually, and reckoning its value at only one penny a ton, the total value would be £1,108,-333, or about $5,000,000. Estimating the value of the sewage of London from the number of inhabitants, the annual value of the entire sewage would lie between £1,000,-000 and £1,250,000.

In view of these statements, the question would, of course, very naturally arise: Can the valuable material contained in the sewage be recovered in manageable form, so as to prove a source of profit? The attempts so to do are prosecuted in

England, the more from the fact that the discharge of sewage into running streams creates such a nuisance that many towns are under an injunction to prevent their disposing of their sewage in this manner: in many cases the sewage must be rendered innocuous.

The recovery of three or four cents' worth of fertilizing ingredients from a ton of liquid* by chemical means, so as to make the operation a profitable one, appears at first sight a discouraging problem. There have not been wanting, however, those who have attempted its solution. Allusion will be made only to some of the more important schemes that have been suggested, and first to one of the oldest, simplest and cheapest,—the lime process.

Lime Process.—The lime process consists in mixing the sewage with a certain proportion of milk or cream of lime, agitating the mixture violently and then allowing it to subside. There settles from the mixture a copious precipitate of a highly putrescible mud, while the liquid flows off in a tolerably clear condition. As far as purifying the sewage is concerned, the process is a failure. At the time of the visit of the Rivers Commission to Blackburn, where the process was in operation, their note on the condition of the river below the outlet of the limed sewage was as follows:—"Horribly offensive, turbid, blackish stream, disengaging most offensive gases, with black masses of putrid mud floating on the surface." This may have been an exceptionally bad case; under skilful management the process succeeds better than here represented. It is certain, however, that the purification effected is but slight, and that the attempt at purification under careless management is worse than useless.

Nor as regards the production of a valuable and saleable manure, has the project proved successful? The suspended matters are, to be sure, removed from the sewage, but these contain only about one-tenth of the valuable constituents: of the dissolved substances, there is removed about one-half of the putrescible organic matter which was in solution, and a portion of the phosphoric acid. The drying of the mud, as

* It will appear presently that the sewage of Boston and Worcester contains even less valuable matter than this amount.

ordinarily conducted, is an offensive operation, and its value when dried, as estimated from chemical analysis, lies between 15*s*. and 17*s*. per ton ($3.62–$4.10). But it was stated that at Leicester the semi-solid manure was bought sparingly by farmers at 1*s*. per ton. This amount is only about one-third of the actual expense of its production.

The use of lime as a precipitant, previous to employing the sewage for irrigation, will be spoken of in a succeeding section.

Blyth's Process.—This process, which has been proposed and tried at various times both in England and in France, attempts to recover the ammonia in the sewage; it consists in the addition to the sewage of super-phosphate of lime and a salt of magnesia, under the supposition that an insoluble phosphate of magnesia and ammonia would be thrown down. It is, however, unfortunately the case that this compound is insoluble only in the presence of an excess of ammonia. Moreover, Professor Way's analyses show that a third part of the phosphoric acid added is left in the solution and constitutes an absolute loss to that extent. The Sewage Commissioners reported that "without accomplishing any part of its intended object, it is the most costly of all the plans that have been proposed."

Holden's Process.—This is a patented process which has been tried at Bradford and consists in mixing the sewage with sulphate of iron, lime and coal dust. The process was examined by the Rivers Pollution Commission who were led by their analyses to conclude that while this process "separates the whole of the suspended matters, it not only fails to remove the putrescible organic matters in solution, but actually (as measured by the organic nitrogen contained in these organic matters) increases their quantity. This it does by causing some of the putrescible organic matters in suspension in the original sewage to pass into solution. The effluent water could not therefore be admitted into rivers without causing pollution. Further, the very large amounts of lime and sulphate of iron added, not only enormously increase the amount of solid matter in solution, but, by their mutual de-

composition into hydrated oxide of iron and sulphate of lime, they communicate to the effluent water a degree of permanent hardness so excessive as to render its admixture with water to be afterwards used for manufacturing purposes extremely objectionable."

An analysis of the air-dried mud showed the presence of only 0.3 per cent. of phosphoric acid, 0.004 per cent. of ammonia, and 0.555 per cent. of organic nitrogen. "A manure of the above composition may be considered as practically worthless."

A. B. C. Process.—Of all the plans at various times proposed for the purification of sewage, perhaps no one has awakened greater interest than Sillar's Patent, commonly known as the A. B. C. process. The patent is in the hands of a stock company, and the representations of those interested in the company are of the most favorable character. It has, moreover, been deemed by the Rivers Pollution Commission of such importance that they have given an entire report to the details of their investigation of it.* The following is an extract from the specification filed by the patentees :—

"We add to the sewage to be purified a mixture consisting of the following ingredients :—Alum, blood, clay, magnesia, or one of its compounds, by preference the carbonate or the sulphate, manganate of potash, or other compound of manganese, burnt clay otherwise known as ballast, chloride of sodium, animal charcoal, vegetable charcoal, and magnesian limestone. Of these substances the manganese compound, the burnt clay, chloride of sodium, and magnesian limestone may be omitted, and it is not essential that both animal and vegetable charcoal should be used. If any of the ingredients named should from any cause be present in sufficient quantity in the sewage it may of course be omitted from the mixture. The proportions in which the ingredients are to be used vary according to the nature of the sewage to be purified; as, for instance, if a large proportion of urine is present we increase the proportion of clay; if the sewage is much diluted we slightly increase the proportion of alum and blood; if it contains a large proportion of street refuse we decrease the proportion of clay."

From the quantities employed it is evident that many of the substances mentioned in the above specification are non-essential: the essential ingredients of the A. B. C. mixture are alum, blood, clay and charcoal. These materials in proper proportion are mixed with water and run into the

* Second Report of the Rivers Pollution Commission. The A. B. C. Process of Treating Sewage. London, 1870.

sewage in a continuous stream: the mixture is then subjected to violent agitation, and allowed to subside in tanks. A heavy flocculent deposit soon settles to the bottom of the tanks, and the clarified liquid is discharged into the river or into tide-water as the case may be. When enough of the sediment has accumulated in the tanks it is removed, dried in a Needham's press or on drying-floors and then offered as a manure.

The proprietors of the patent, the Native Guano Company, limited, claim for their process two advantages: first, that it purifies the sewage to such an extent that it may, without harm, be discharged into a river; secondly, that they produce a valuable manure, a manure costing about 25*s.* a ton to manufacture, and worth, at least, their selling price, £3 10*s.* ($17) a ton.

As already stated, the process has been subjected to a searching investigation at the hands of the Rivers Commission. As there is no reason to suppose that the Commissioners were actuated by any motive other than a desire to ascertain the truth in the matter, full weight must be given to the result of their examination. It will not be necessary in this place to detail the results of their analyses, nor the methods they employed; it will suffice to give their conclusions. They say:—

"Our investigations into Sillar's or the 'A. B. C.' process of treating sewage, as carried out at Leicester and Leamington, extending over nearly two years, have led us to the following conclusions:—

"1. The process removes a large proportion of the *suspended* impurities from sewage, but on no occasion, when we have seen it in operation, has this removal been so complete as to render the effluent sewage admissible into running water.

"2. The 'A. B. C.' process removes a very small proportion of the soluble polluting matters from sewage. After treatment by this process, the effluent sewage is very little better than that which is obtained by allowing raw sewage to settle in subsidence tanks.

"3. * * * * * * * * * *

"4. The manipulations required for the extraction and drying of this manure are attended with a nauseous odor, especially in warm weather, and would occasion a serious nuisance if the works were situated in or near a town."

It is stated that the effluent water, in a very few days, becomes not only putrid, but nearly if not quite as bad as the

original sewage and this is what would be expected from the analyses published.

We visited this summer, the experimental works at Crossness, where about 500,000 gallons of London sewage can be daily treated, and the works at Leeds, where a portion of the town sewage is subjected to the A. B. C. method of purification. At Crossness the sewage of all of London south of the Thames is received and pumped by steam-power into huge storage tanks, from which at low tide it is run out into the river. The Native Guano Company take a portion of the sewage from these tanks, and after subjecting it to their treatment run the effluent water into the river. From the nature of the case it is thus impossible to distinguish the effect of the purified sewage on the river from that of the raw sewage which is discharged in close proximity to it. The difference in the appearance of the foul, black London sewage received at the works, and the nearly clear and odorless liquid which, after the purification, is discharged over a miniature fall into the Thames is most striking. The sense of sight and that of smell concur in pronouncing an amelioration effected. The works at Crossness are arranged with neatness and taste so as to strengthen the favorable impression made upon the casual visitor. To form, however, just conclusions of the efficiency of the process, the results of the chemical analyses must be relied upon.

At Leeds the portion of the sewage which has been subjected to the A. B. C. treatment runs back into the canal through which the main body of the sewage flows, and here there is no opportunity for judging of the completeness of the purification. It is to be remarked that the town of Leeds is so well satisfied with the process that arrangements are being made to treat the whole of the sewage in this way. On the other hand, Leamington, where it was in use for a time, has given it up and is making arrangements to utilize its sewage by irrigation. Both at Crossness and at Leeds the matter deposited in the settling tanks was allowed to drain and then dried on heated iron plates. At both places, however, arrangements were being made to dry the sludge by means of a Needham's press; the drying on the floors was, at least, at

the time of our visit, attended by no such disagreeable odor as has been attributed to the operation.

As regards the value of the manure produced, the so-called "native guano," the statements made with regard to the amount of purification effected in the sewage will lead to the supposition that it cannot possess any great value above that of the materials employed. It is asserted, however, by the proprietors of the patent, that the manure is readily disposed of at the selling price, £3 10*s.* ($17) per ton, and their circular contains certificates from those who have used it, attesting its great value. Much weight cannot, of course, be placed upon such statements, as no artificial fertilizer, probably, was ever brought into the market without a host of certificates to its extraordinary properties. Those who are opposed to the process, or disbelievers in it, doubt the genuineness of many of the sales, and point to the mass of the accumulated manure at Leeds, which is not put upon the market. The A. B. C. manure consists virtually of the insoluble matters of the A. B. C. mixture, of which a large proportion is nothing but clay, together with the suspended matters of the sewage and about one-half of the nitrogenous organic matter previously held in solution. The Rivers Pollution Commissioners consider the native guano "theoretically worth probably one-half more than that resulting from the Leicester lime process, twenty tons of which, according to a chemical valuation, ought to be worth as much as one ton of Peruvian guano, but for which not more than one shilling per ton can be obtained from the farmers of the district."

Dr. Voelcker finds the value of the manure, as estimated from chemical analysis, to vary from 14*s.* 6*d.* per ton to £1 13*s.* 6*d.*

Messrs Lawes and Gilbert, who are eminent as authorities on the subject, give their opinion with reference to the value of the A. B. C. manure as follows :—

"Assuming such a manure to be produced in large quantities, our opinion is that it would certainly be worth more per ton than stable-dung, provided the nitrogenous substance were in an easily decomposable condition, and its nitrogen readily available, and provided the phosphoric acid were also in a readily soluble condition; but if the nitrogen and phosphoric acid were not in such conditions, it may be a question whether the 'A. B. C.,' deposited manure or stable-dung would be the most valuable. The result would de-

pend in a measure on the quantity of the respective manures in the market, the cost of carriage, and other local circumstances. Stable-dung would, however, probably have the preference for market gardening."

Phosphate Process.—Various other attempts besides those already described, have been made to purify sewage by chemical means. Perchloride of iron alone or with addition of lime, salts of zinc and manganese, carbolic acid or carbolate of lime, have all been employed. The most favorable result obtained is the clarification of the water and the delay of the putrefaction which, however, inevitably sets in after a longer or shorter time.

The phosphate process devised by David Forbes, F. R. S., and Dr. A. P. Price, deserves individual mention, if for no other reason, from the fact that its devisers do not claim everything for it. The process may be best described, and its claims understood, by the quotation of a few extracts from a paper read by David Forbes, F. R. S., before the British Association at its meeting in 1870 :—

"This process is founded on the fact that certain mineral phosphates, easily obtainable, especially those containing alumina, when in a hydrated or freshly precipitated state, eagerly combine with the organic matter contained in the sewage, it being sufficient merely to agitate them in the most fœtid sewage to deprive it of all its odor and color, even if tinctorial substances of great intensity be present in the solution at the same time; while the phosphate of magnesia combines with the ammonia contained in the sewage, and precipitates it also in the state of the double phosphate of ammonia and magnesia. The precipitate subsides rapidly, and the water drawn off is quite transparent, colorless, and has so little perceptible taste, that you can drink it without repugnance if you can only banish the idea from your minds that it has only just been obtained from so filthy a source.

"The process is an extremely simple one, and requires nothing beyond a reservoir for holding the sewage whilst it is submitted to the operation. The phosphates are preferably added, in the state of solution, in sulphuric or hydrochloric acid, to the sewage, and their precipitation, in the hydrated form, along with the organic matter in the sewage, and more or less of the ammonia (dependent on the strength of the sewage and amount of time allowed to stand), is instantaneously effected by the addition of a small quantity of milk of lime, just sufficient to neutralize the acid which holds them in solution, the deposit subsides rapidly, and the supernatant water may at once be run off and discharged into the river. * * * As regards the phosphate process, we do not claim that the effluent water is by anything like as pure as the water supplied for drinking purposes, but are content with showing that it is as transparent and colorless as ordinary river-water ; that it can be taken into the mouth, and even drunk, without repugnance; that fishes can live in it; and, most important of all, that it is not

only free from any offensive smell, but, as in the specimen on the table before you, has remained for months, during the entire hot summer of this year, without showing any tendency to putrefy or emit any disagreeable odor."

The statement with regard to the delay in the setting in of putrefaction in the effluent water would seem to be borne out by experiments on a large scale; it would seem, however, from analyses made by Dr. Voelcker, that the amount of ammonia carried down by the precipitate is practically nothing, and it is probable that even when lime is added a greater or less proportion of phosphoric acid goes off in solution. The manure is of course valuable on account of the value of the phosphates used in its manufacture; it is not probable, however, that its manufacture could be made a means of profit. As preceding the use of the sewage in irrigation the process might under certain conditions be of value.

In view of the rapid advances made from year to year in all the natural and physical sciences, it would be hard to say that we shall never be able to purify sewage and to obtain in concentrated form its valuable ingredients by some purely chemical process. The large amount of the accompanying water, the solubility of the salts of ammonia which are the chief fertilizing substances, make the prospect exceedingly doubtful. It is, moreover, true that up to the present time no satisfactory plan has been devised. While some of the processes already described, and others which we have not felt necessary to mention, have had their ardent advocates, the mass of those who are to be considered authorities on the subject have come to this conclusion: that the only way at present available for *purifying* the sewage is that afforded by *filtering it through natural soil.* The purifying power of natural soil is very great; and if sewage be applied to land properly drained, the organic matters are entirely destroyed, that is, are converted into innocuous compounds.

Early in the history of the sewage difficulty, attempts were made to purify the sewage by simple filtration through beds of gravel or ashes; the best effect in any case produced was the removal of the suspended matters; the amount of dissolved impurities not being appreciably lessened. The black,

solid matter separated by this straining process was mixed with street-sweepings and ashes and sold for manure.

Differing from these crude efforts in many respects is the method known as "intermittent downward filtration" through natural soil. The cleansing powers of soils vary very much, the difference being, in great measure, due to differences in porosity and state of division; still all soils have very considerable cleansing properties, and if the sewage be supplied in not too large quantities, it will, after passage through the soil, issue as a clear, odorless effluent water, containing very little ammonia or organic matter, the nitrogen which is present being almost entirely in the state of nitrates and nitrites. It is essential that the sewage should be supplied to a given portion of soil *intermittently* and that there should thus be given to the filter-beds an opportunity for aeration.

The Rivers Pollution Commission conducted a great many experiments on the purifying power of various soils. That which gave the most favorable results was a light, yellowish-brown loam from the marlstone of the lower oölite near Dursley, in Gloucestershire. In this case they found that one cubic yard of soil would cleanse at least 9.9 gallons in twenty-four hours, which is equivalent to the cleansing of nearly 100,000 gallons of sewage per day for every acre, provided that the grounds were underdrained at the depth of six feet. A light sand of bright red color from the new red sandstone at Hambrook, in Gloucestershire, purified satisfactorily only 4.4 gallons of London sewage per cubic yard during the twenty-four hours. A sample of peat from Lancashire worked rather poorly, although it seemed probable that, after use for some time, the peat would purify about four gallons per cubic yard per twenty-four hours.

It would seem that almost any porous and finely-divided soil will serve for the purification of sewage, the amount purified in a given time depending upon the nature of the soil. It is, however, evident that the process is not simply mechanical but that chemical action is concerned in it. The question very naturally presents itself, whether in conducting the process on the large scale the pores of the soil will not ultimately become clogged so that the filter will cease to act. It is possible that this might happen after a long time, if the

sewage contained a large quantity of suspended matter. If the sewage be allowed to settle or if the suspended matters be removed by the treatment with lime, or with lime and clay, it is probable that the duration of the efficiency of the filter would be practically unlimited.

The cleansing property of natural soil, which has been just described, may be taken advantage of for the purification of sewage according to one of two systems. When the sewage is supplied to a limited area of land in quantities approaching the maximum which can be cleansed by that amount of land, the process is known as "intermittent downward filtration." This process aims at the *purification* of the sewage and may without hesitation be pronounced successful. The climate of England is such that the process may be carried on even in winter, and the temperature of the sewage, as it comes from the towns, prevents the liquid from freezing. As the most extensive and best example of "intermittent filtration" is carried out in connection with sewage irrigation, its description will appropriately follow that of the irrigation process, which is the second method of taking advantage of the cleansing properties of natural soil. In this method, the sewage is applied over a large area, and while, if the land be properly underdrained and the sewage properly distributed, the organic matters of the sewage are in great measure destroyed and the nitrogen which is not taken up by plants escapes as nitrites or nitrates, yet what is aimed at is not so much this oxidation of the ammonia and the nitrogenous organic matter, as the appropriation of the fertilizing ingredients by the growing crops. As far as the furnishing of a purified effluent water is concerned, the process is a success: that *under proper management*, the use of sewage in irrigation may be made to repay, to a greater or less extent, the expense attending its purification, there is no doubt. The opinion of the Committee of the British Association as well as that of the Rivers Commission, is that the true solution of the sewage difficulty is in its employment for purposes of irrigation. The analyses of a great number of samples of effluent water from the various sewage-farms gave, in nearly every case, satisfactory results, while, say the Commissioners :—

"On the other hand, we have never taken a sample of effluent sewage that had been subjected on a working scale to any other cleansing process, which was not still so highly charged with putrescible animal matters as to be utterly unfit for admission into running water. Irrigation is the only process of cleansing sewage which has stood the test of experience, and unless it be extensively adopted, there is but little hope of any substantial improvement in our sewage-polluted rivers. * * * * * We have no hesitation in recommending irrigation as the only plan of dealing with the sewage difficulty at present known to us, which at once abates a nuisance and turns to profitable account an otherwise valueless material."

These quotations are not to be understood as unfavorable toward intermittent filtration as a means of simply purifying sewage: the success of this process on a large scale had not been fully established at the date of the report quoted.

Sewage irrigation has many opponents, and many ill-managed sewage-farms give reasonable cause for criticism. Several things are necessary for the successful conduct of sewage farming, which does *not* consist in flooding low or undrained land with sewage, allowing it to run from the surface of the land unpurified and having contributed to the growth only of a coarse, rank grass. The ground must be properly laid out, the sewage supplied methodically and according to the needs of the growing crop; above all, there must be a directing mind, for a sewage-farm will not take care of itself. Thus conducted, the farm need not be a nuisance, the sewage will be purified and the crops increased in amount without deterioration in quality.

Sewage irrigation is no novelty. In Italy, in the neighborhood of Milan, sewage has long been used for purposes of irrigation, and the Craigentinny meadows, in the neighborhood of Edinburgh, have been treated with sewage for many years. At Milan the liquid refuse of the city is collected in large sewers which join one another and meet in a canal called the "Vettabbia." This is made to ramify and serve for the irrigation of about 4,000 acres of land, after which it falls into the river Lambro, about ten miles below the city. The amount of sewage supplied to the land is at about the rate of the liquid refuse of forty persons to the acre. The land irrigated with sewage is devoted mainly to the cultivation of grass, and the crops are superior to those raised upon neighboring lands which are irrigated with water simply. The

severity of the winters is not such as to prevent the application of sewage; in fact, the somewhat elevated temperature of the sewage as it comes from the town protects from frost the fields to which it is applied.

The meadows near Edinburgh, although often cited as an example, do not afford a fair example of sewage irrigation as a means of purifying sewage. Here the liquid refuse from a population of 100,000 persons is distributed over about 400 acres only. The area is not sufficient to take up the whole of the filth brought down by the water and as a result, the sewage is very imperfectly purified, while large crops of a rather coarse grass are obtained.

A good example of a well-conducted sewage-farm is Breton's farm,* at Romford, near London. Romford is a town of 8,000 inhabitants: the refuse of about 7,000 people is discharged into the sewers and the dry-weather flow is about 250,000 gallons per day. The average composition of the sewage was (Sept. 3 and 4, 1869), in 100,000 parts:—

Solid matter in solution, ...	98.5
Suspended matter, ...	19.75
Ammonia, ...	1.2
"Albuminoid Ammonia,"	1.0
Chlorine, ...	14.5

The sewage is thus seen to be weak as compared with London sewage or with the "average" of the Rivers Commission. (See Table I.)

We visited Romford on the 13th of August, 1872: the farm comprises about 125 acres, mostly laid out in beds in the ridge and furrow system: the soil is light and sandy with a gravelly subsoil. A portion of the farm is underdrained at a depth of five or six feet. The sewage is brought from the town in iron pipes and received in storage tanks: it is thence pumped up into the carriers, which are in part painted sheet-iron troughs and in part concrete conduits. Although the day was warm there was no offensive smell either from the

* An account of a visit made to "Breton's Farm" in 1870, by the Chairman of the State Board of Health may be found in the Second Annual Report of the Board, page 241.

tanks or from the open carriers. The sewage in the tanks is covered with a thick, black scum, under which the sewage flows into and from the tanks. This scum prevents the odor of the sewage from being perceived, but when it has increased so that its removal becomes necessary, it is stated that the operation is attended by a fearful stench.

A great variety of crops are cultivated,—Italian rye-grass, cabbages, potatoes, turnips, peas, beans, Indian corn, etc. The vegetables grow luxuriantly (and the weeds as well); cabbages of good size and appearance grew on what was a mere gravel-pit, and a very promising crop of onions was receiving the sewage at the time of our visit. The lessee of the farm pays the town of Romford £600 per annum for the sewage pumped up into the troughs.

This farm is taken for description partly because for several years the Sewage Committee of the British Association have here carried on a series of experiments, an account of which appears in the annual reports of the Association.

A difficulty which attends the use of sewage for irrigation is the necessity of providing for its reception under all conditions of its flow, night and day, summer and winter, in dry weather and in times of storm. This difficulty is met at Romford by storing the sewage in tanks, where most of the suspended matters are deposited. This deposition of the suspended matters is a positive advantage but their subsequent removal from the tanks would create an intolerable nuisance in any inhabited locality. To obviate this nuisance and to afford a means of disposing of the sewage-sludge,—a disagreeable mixture, of little agricultural value,—a method of treating sewage has recently been proposed by Gen. H. Y. D. Scott. He adds to the sewage a mixture of lime and clay, allows the flocculent precipitate which is formed to subside, dries the sludge and burns it in kilns. This process of treatment is carried on at Ealing, near London. (The sewage, however, is not used for irrigation, but after this treatment is run directly into the river.) The product of the calcination is virtually "Portland cement," which is the "strongest cement known and which is made by thoroughly incorporating, by mixture with a large body of water, chalk or lime and clay in the proportion of two parts of *quicklime* to one

part of clay: the compound is allowed to settle in large tanks, the mixture dried on hot plates and then calcined at a high temperature; the burnt material is then ground to a fine powder."

Gen. Scott states that "when the mixture of lime and clay is added to sewage water, a precipitate rapidly subsides, carrying with it all the suspended mineral and organic matters together with a considerable portion of such matters as exist in the sewage in a state of solution. The organic matter carried down generally amounts to one-third or one-fourth of the whole, and supplies almost a sufficiency of fuel for the calcination of the lime and clay, even to the point at which Portland cement is produced. It is only necessary to set the dried mixture fairly alight and it will burn freely."

We witnessed this process of treating sewage as it is carried on at Ealing. As a means for the complete purification of sewage it is insufficient, no chemical analysis being necessary to prove the impure condition of the effluent water; as a means of getting rid of the sewage sludge it seemed valuable. The drying of the sludge was attended by no very perceptible odor, and it is stated that the deposit will stand for months without giving off any disagreeable smell. The deposit differs in this respect from that produced by the addition of lime alone; the presence of the larger amount of earthy matter, preventing in a measure the tendency to putrefy.

Gen. Scott prefers to add the mixture to the sewers in the town, since "the precipitate formed exercises a scouring action and the decomposing slimy matter usually found adhering to the bottom and sides of the drains is entirely got rid of, and the sewage arriving at the outfall is really fresh sewage, which is, as is well-known, free from the deleterious influences of that which is undergoing decomposition." Specimens of pebbles from the drains of the town bear out this statement.

The cement produced in this way is really a good cement, but the claims of the process to consideration are based upon the fact of its affording the means of getting rid of the less valuable part of the sewage—the suspended matters. In districts where lime is applied by farmers directly to the land, it has been proposed to modify this process by precipitating

with milk of lime without the addition of clay, calcining the deposit when dry, and applying it, after reburning, to the land. By this means the amount of phosphates in the lime is increased, and the lime would be worth somewhat more, agriculturally, than in its natural state; it is doubtful, however, whether it would really be worth more than the wet sludge; it would certainly be more readily handled.

The difficulty of the irregular supply of sewage is also met by combining the two systems of irrigation and intermittent filtration,—that is, by laying out certain filtering areas on to which the sewage may be run when not needed for irrigation. This double system is carried out at Merthyr Tydfil in Wales, where the land has been laid out under the direction of J. Bailey Denton, C. E.

The population of the district of Merthyr Tydfil is about 50,000, but many of the dwellings are not connected with the sewers, and the sewage, which in dry weather averages 900,000 gallons per day, is very dilute. To purify this amount of sewage an area of twenty acres is laid out in beds of five acres each, to each of which the sewage is applied for six hours continuously. The soil is a fine, deep, friable loam, and is underdrained at a depth of six or seven feet at interval of about forty yards. The drains run underneath the roads, so that the sewage cannot pass directly into them with the risk of imperfect filtration. While the filtering areas were in process of construction the sewage was distributed over two beds only, of five acres each. Each bed received the sewage for twelve hours and the effluent water was satisfactorily pure.

Connected with the filtering areas are portions of land on which the sewage is used for purposes of irrigation, but on the filter-beds themselves, contrary to what might be expected, it has been found possible to raise good crops. When not under rye-grass, the land is thrown into ridges and furrows, and on the crests of the ridges, three feet apart, the vegetables are planted and are thus elevated above the sewage which is run into the furrows between them.

The sewage before being distributed over the filtering areas is treated with lime, and caused to pass through a rough filter made of crushed slag. The separated matter is not very

readily disposed of, but might perhaps be burned, as suggested by Gen. Scott. The clarified sewage, when applied to the land, although in such large quantities, gives rise to no offensive odors, even in the hottest summer-weather.

For cases where it is proposed to adopt "intermittent filtration" *per se*, that is, not in connection with irrigation, in order to secure permanence of effect and a profitable return, and to prevent the possibility of nuisance, Mr. Denton proposes: first, that instead of using only one series of filtering areas (consisting of the four plots necessary for daily use), three series of an equal extent should be prepared for use, each of itself capable of cleansing the sewage, and, by special preparation, of growing crops at the same time; second, that each series should be used for purification for a year only at a time so that two out of the three series may be devoted to plant-growth. In this way a very great return per acre may be obtained from the two series not in use for filtration, for they receive only that amount of sewage which will produce the most abundant yield.

The amount of land necessary for purifying the sewage of any given town, would vary very much according to the nature of the soil and the strength of the sewage. With soil of good quality underdrained at a depth of six feet, "average sewage" should be purified at the rate of 3,300 persons to the acre, but the purification would be rendered permanently secure by laying out three series of beds as above suggested, in which case each acre would be supplied on the average with the sewage of 1,100 persons.

Objections have been made to the application of sewage to growing crops, not only from the idea that such application may give rise to offensive odors, but also on the ground that portions of the sewage may become attached to the stalks of the grass and to the vegetables, making them unwholesome as food, and even the means of propagating certain parasitic diseases. These charges can be completely disproved only by a large experience, but the weight of evidence tends to show that such fears are groundless. Cattle fed exclusively on sewaged crops for long periods, and then slaughtered, have been found entirely free from parasitic disease.

On the Treatment and Utilization of Sewage in Massachusetts.

By the preceding review of the aspect of the sewage question in England, we reached the conclusion that, up to the present time, there has been no way devised of satisfactorily purifying sewage, except by filtering it intermittently through natural soil; we have also seen that, under favorable conditions, this filtration may be so conducted as to utilize in irrigation the fertilizing ingredients of the sewage. As we turn now to examine the conditions which exist in our own State, it will not be at all necessary to consider the various plans, which have been tried abroad and found wanting. The question will be simply, Can we purify our sewage by the means which have been found to answer in England, and is there hope that a return greater than the outlay involved may be obtained by such a disposal of the liquid refuse of our towns?

The only cities as yet provided with anything like a comprehensive sewerage system are Boston and Worcester; several other of the larger towns have the beginnings of such a system, and the introduction in many others of a general water-supply, will lead to the adoption of some system of sewerage. To our minds, the question with reference to the inland towns, to the towns situated, like Worcester, on running streams, presents itself in a different aspect from that offered by sea-ports like Boston. We propose, therefore, first to consider the character of the sewage of Boston, and inquire into the necessity of a different disposal from that which is now made of it.

Boston affords unusual facilities for the discharge of the sewage into tide-water: there are, in fact, forty or more localities where the sewers discharge themselves between high and low water mark. The city is provided very generally with water-closets, yet, during the year 1871, there were removed 5,000 cords of night-soil from privies within the city limits, besides 10,000 cords of street-sweepings and cess-pool matter. The storm-water finds its way into the sewers, there being catch-pits to intercept the heavier portions of the street-wash, and the contents of these cess-pools, as well as the solid sewage-matter which accumulates in the man-holes,

are from time to time removed. The sewers are all comparatively short, the sewage does not remain in them long enough to become offensive, and the sewers are, as a general rule, kept clean, owing to the abundant supply of water, and to the fact that rain-water is discharged into them.

It may be remarked in passing, that the material above alluded to as being removed from the man-holes, although black and rich looking, has in reality very little value. A sample taken, October 30, from the corner of Brookline and Tremont Streets, dried at 100° C., even after removing the pebbles which would not pass through a sieve of twenty meshes to the linear inch, lost only 4.1 per cent. on ignition; the percentage of nitrogen in the dry material was only 0.0126, and the silicious matter insoluble in acid amounted to 88.10 per cent.

The present system of Boston sewerage may be regarded both in its sanitary and economical relations. In the first place, it is of the utmost importance, in so far as public health is concerned, to be absolutely *rid* of the sewage. Our population is dense, and we cannot afford to retain these foul materials among us. Whether there be more or less money value in the water flowing from our sewers; whether in each ton of such water there be one, two or three cents' worth of a fertilizer, which may or may not be extracted and saved by chemical or other processes, is of comparatively little account. The health of the city has a positive and appreciable money value. Health is truly wealth. We think no better bargain can be made at the present time, than to deliver the sewage in strong tidal currents. It is now but partially dispersed: a large portion of the insoluble contents of the sewers is deposited in the docks or on the mud flats of Charles River. If this could be conducted to deep water, where it would meet a strong ebb-tide, by sewers extending to the ends of the wharves, or in the case of Charles River, by a capacious collecting sewer, reaching as far as the Charlestown bridges, it would be of great public advantage.

It is asserted that the discharge of the sewage into tide-water, contributes to the shoaling of the harbor. These objections are unfounded: it is true, that a deposit takes place in the docks into which the sewers empty, and neces-

sitates occasional dredging; as regards its influence on the harbor, the Harbor Commissioners "find no proof whatever of injury from the discharge of sewage. It is effectually and completely dispersed, and no trace of it is found in any bars or shoals outside of the docks and wharves."

On economical grounds, objection is made to the emptying into the sea of so much valuable fertilizing matter which should be returned to the land. It will be of interest in this connection, to endeavor to estimate roughly the value of Boston sewage.

The value assigned by English authorities to the solid and fluid excreta of the average individual of a mixed population, has already been stated to lie between $1.60 and $2.00 per annum: calculating from the same data, but taking into account the present price of different natural and artificial fertilizers, we shall feel inclined to set the value at about $2.75. The population of Boston in 1870 was 250,513: supposing that all the excretal matter found its way to the sewers, they would discharge annually, fertilizing material to the amount of $690,000. It has already been stated, that a considerable portion of the houses are not provided with water-closets, so that perhaps one-half of the excreta of the city is not discharged directly into the sewers. Therefore, the amount just stated far exceeds the value of the refuse matter from human sources. It is, to be sure, true that other refuse matters find their way into the sewers; some of these matters are, no doubt, of value, as the manure washed from the streets, and soap-suds and sink-wash; still, the amount stated above ($690,000) must be very much too large as a statement of the worth of what is valuable in the sewage at present. Taking also into account that even when privies are in use, a considerable part of the liquid refuse enters the sewers, we shall probably be safe if we diminish the above amount by one-third, and consider as the approximate annual value of the present sewage of Boston, the sum of $460,000.

Now in what state does the valuable matter of the sewage find its way into the sea? The amount of water used in the city during the year 1870–71, averaged about 15,000,000 gallons daily, or say 5,500 million gallons, or 23,000,000 tons annually. This amount of water enters the sewers increased

somewhat in amount, so that we may consider the annual amount of sewage as 25,000,000 tons, independent of the amount of water due to the rain-fall. If we consider simply this as the amount of dry-weather sewage, we have fertilizing material worth $460,000, diluted to 25,000,000 tons of liquid, and each ton will be worth 1.84 cents. If, however, we take into account the fact that the annual rain-fall of Boston is over fifty inches, and that fifty inches of rain-fall over 10,000 acres would amount to 56,500,000 tons, we see that the average value of the sewage must be very much lowered. If we suppose that three-fifths* of the rain-fall enters the sewers, we should have the value of the sewage reduced from 1.84 cents per ton to seventy-eight hundreths of one cent.

This statement is, of course, a very general one. We have also attempted to ascertain something of the value of Boston sewage from analytical examination of a number of samples kindly furnished us by Mr. W. H. Bradley, superintendent of sewers. The samples examined were taken under a considerable variety of conditions, at various hours of the day, and on various days of the week. The results are expressed in the following tables.

These results, which are brought into Tables II. and III., are thus separated for the reason that the specimens of Table II. were taken under such conditions that they can hardly be regarded as normal sewage; the large amount of chlorine found in most of them shows that there must have been a greater or less admixture with sea-water :—

* The area of the city, according to the Auditor's report for 1869–70, is as follows :—

Original area of uplands in Boston proper,	690 acres.
Area added and in process of filling,	880 "
of South Boston,	900 "
of East Boston,	800 "
of Roxbury,	2,184 "
of Dorchester,	4,533 "
Total area of Boston,	9,987 acres.

Of this territory, the portion unprovided with sewers includes a part of the Back Bay lands, one-quarter of South Boston, one-half of East Boston, one-half of Roxbury and all of Dorchester.

It is to be said that a portion of the rain-fall which eventually enters the sewers, does so indirectly, sinking through the ground and then entering through the walls of the sewers, so that even if the storm-water were excluded from the sewers, the 25,000,000 tons mentioned above would be still somewhat diluted by the rain-fall.

TABLE II.—*Examination of Boston Sewage.* (Results expressed in Parts per 100,000.)

Number.	DATE.	Solid Residue of— Filtered Sewage.	Solid Residue of— Unfiltered Sewage.	Suspended Matters by Difference.	Ammonia.	Albuminoid Ammonia.	Phosphoric Acid.	Chlorine.	Locality.
1	Tuesday, June 18, 4.00, P. M.,	177.40	–	–	3.400	0.230	0.080	71.5	Berkeley Street.*
2	Friday, " 21, 7.00, A. M.,	445.90	–	–	0.406	0.372	0.408	57.8	Concord Street.†
3	" " 21, 7.00, A. M.,	551.37	–	–	9.460	0.640	2.570	250.7	Albany Street.‡
4	Monday, " 24, early,	2,049.02	–	–	0.704	0.738	1.514	968.5	Central Wharf.§
24	Friday, July 27, 8.45, A. M.,	392.30	398.30	6.00	2.380	0.680	1.240	180.0	Harvard, cor. Albany Street.
30	Tuesday, Aug. 6, 3.25, P. M.,	261.00	318.00	57.00	–	0.850	4.160	101.0	Broad, cor. Congress Street.
31	Friday, " 9, 12.10, P. M.,	234.50	417.50	182.50	4.488	0.578	3.120	20.0	Pearl, cor. Purchase Street.
32	" " 9, 11.50, A. M.,	3,284.50	3,307.00	22.50	–	0.340	Trace.	1,354.0	Broad, cor. Belcher Lane.
33	" " 9, 11.30, A. M.,	188.00	204.50	16.50	–	0.408	1.960	89.0	Clinton, cor. Commercial Street.
34	Monday, " 12, 1.40, P. M.,	1,265.20	1,308.00	42.80	–	0.476	2.200	570.0	Richmond, cor. Commercial Street.
38	Thursday, " 15, 3.25, P. M.,	186.00	228.10	42.10	3.400	0.442	1.880	80.0	Clark, cor. Commercial Street.
41	Tuesday, Sept. 3, 9.20, A. M.,	647.00	662.50	15.50	1.734	0.068	1.160	284.0	Warren Bridge, cor. Causeway St.
42	" " 3, 9.10, A. M.,	420.90	445.00	24.10	2.890	0.170	1.400	186.0	Canal Street, cor. Causeway Street.
47	Monday, " 9,	–	2,862.00	–	0.210	0.100	–	1,360.0	Broad Street, cor. Belcher Lane.
48	" " 9,	85.50	156.00	70.50	3.060	0.500	–	33.0	Clinton Street, cor. Commercial St.
49	" " 9,	406.50	482.50	76.00	3.600	0.775	–	192.0	Richmond St., cor. Commercial St.

* Mineral suspended matter, 6.99; Organic, ——.
† " " " 1.180; " 1.140.
‡ Mineral suspended matter, 0.835; Organic, 1.165.
§ " " " 4.890; " 16.280.

TABLE III.—*Examination of Boston Sewage.* (Results expressed in Parts per 100,000.)

Number.	DATE.		Solid Residue of— Filtered Sewage.	Solid Residue of— Unfiltered Sewage.	Suspended matters, by Difference.	Ammonia.	Albuminoid Ammonia.	Phosphoric Acid.	Chlorine.	Locality.
5	Monday,	June 14, early, . .	180.60	–	–	5.429	1.018	2.220	75.8	Cambridge Street.*
10	"	July 1, " . .	49.00	64.00	15.00	–	–	–	11.5	Washington Street, Roxbury.
11	"	" 1, " . .	58.00	98.50	40.50	3.600	0.782	1.072	16.0	Tremont, corner Concord Street.
12	"	" 1, " . .	57.50	72.00	14.50	3.366	3.128	1.151	15.0	Dedham, corner Washington Street.
13	"	" 1, " . .	44.80	80.00	35.20	3.400	2.652	0.880	9.5	Union Park.
18	Tuesday,	" 9, 8.45, A. M., .	42.00	64.70	22.70	3.200	1.360	2.160	12.0	Dedham, corner Tremont Street.
19	"	" 9, 9.10, A. M., .	63.00	77.50	14.40	1.360	1.460	1.880	18.0	Union Park.
20	"	" 9, 9.30, A. M., .	78.00	94.50	16.50	1.904	0.544	2.640	29.0	Dover, corner Washington Street.
21	Wednesday,	" 10, 8.00, A. M., .	48.50	61.00	12.50	1.292	0.340	2.240	17.0	Union Park.
22	"	" 10, 8.10, A. M., .	35.00	54.00	19.00	2.210	0.884	1.800	8.0	Davis Street.
23	"	" 10, 8.30, A. M., .	38.00	60.20	22.20	1.564	0.748	1.960	12.0	Church, corner Tremont Street.
25	Friday,	" 26, 9.00, A. M., .	68.50	92.30	23.80	2.856	1.020	2.800	25.0	Beach, corner Kingston Street.
26	"	" 26, 1.45, P. M., .	53.50	105.00	51.50	0.348	0.348	0.840	15.0	Dudley Street.
27	"	" 26, 2.30, P. M., .	59.50	65.50	6.00	0.540	0.408	0.840	14.0	Beach, corner Kingston Street.
28	"	" 26, 3.00, P. M., .	43.00	72.80	29.80	2.040	0.747	1.200	11.0	Summer, corner South Street.
29	Tuesday,	Aug. 6, 3.15, P. M., .	73.50	87.80	14.30	2.720	0.918	1.880	23.0	Summer, corner South Street.

35	Monday, Aug. 12, 1.45, P. M., .	54.60	94.80	40.20	2.550	0.510	1.920	12.0	Fleet, corner North Street.
36	Wednesday, " 14, 7.30, P. M., .	74.00	129.50	55.50	0.680	0.340	1.880	26.0	Concord, corner Harrison Avenue.†
37	" " 14, 7.45, P. M., .	109.70	133.50	23.80	0.238	0.340	2.120	43.0	Union Park.†
39	Thursday, . " 15, 3.35, P. M., .	62.50	95.30	32.80	2.210	0.340	2.000	10.0	Battery, corner Commercial Street.
40	" " 15, 3.45, P. M., .	103.50	134.50	31.00	0.340	0.272	0.840	28.0	Causeway Street.
43	Tuesday, . Sept. 3, 9.00, A. M., .	–	–	–	4.488	0.408	2.000	27.0	Lowell, corner Minot Street.
89	Wednesday, Oct. 30, . . .	46.80	60.20	13.40	4.200	0.600	–	14.0	Brookline, corner Tremont Street.
90	" " 30, . . .	44.30	67.30	23.00	4.000	0.650	–	14.0	" " " "
91	" " 30, . . .	49.50	65.50	16.00	5.000	0.600	–	14.0	" " " "
92	" " 30, . . .	48.50	65.70	17.20	5.000	0.600	–	14.0	" " " "

* Mineral suspended matter, 8.08; Organic suspended matter, 20.76. Total, 28.84.

† Light rain; just after a heavy thunder shower.

Explanation of the Tables.—In these tables, the results are expressed in parts in 100,000. The number of pounds per ton may be found by multiplying by two and moving the decimal point two places to the left.

As the sewage is filtered with some difficulty, and the suspended matters cannot be thoroughly washed in any reasonable time, it has been thought best to evaporate separate portions, one portion filtered and the other unfiltered, and thus to determine the suspended matters by difference.

The "ammonia" represents the amount of ammonia given off when the sewage is distilled with carbonate of soda, and includes that existing in the liquid as ammonia, or its salts, and also, that coming from the decomposition of any urea present.* The residue from this distillation was treated with alkaline permanganate of potash, and the ammonia produced by the action of this agent on the albuminous matters of the sewage, gives an amount of ammonia as indicated under the head of "albuminoid ammonia." The amount of ammonia given off by various nitrogenous bodies under this treatment is different, although very constant in each particular case. In a mixture of the nature of sewage, the amount of nitrogenous organic matter may be somewhat closely approximated by multiplying the amount of "albuminoid ammonia" by ten.

The ammonia was, except in a few cases, determined by the use of Nessler's reagent. The phosphoric acid was determined in the *unfiltered* sewage: the other determinations were made in the filtered sewage.

After the examinations recorded in Tables II. and III. had been made, it was thought best to confine our further investigations, to samples taken from a single sewer, but taken at different hours of the day and night. The sewer chosen was the Summer Street sewer. The amount of territory drained by this sewer, before reaching the point at which the samples were taken, is stated by Mr. Bradley to be as follows:—

* We do not feel confident as yet, in asserting the presence or absence of undecomposed urea in the sewage; we have satisfied ourselves, however, that if any is present, it is decomposed by this treatment with carbonate of soda.

Private enclosures, ...	583,000	square feet.
Public enclosures (Common, Cemetery, State House, &c.), . .	122,000	" "
Streets, ...	267,000	" "
Total, ...	972,000	square feet.

The territory drained contains public buildings, dwelling-houses and stores. The results of the examinations are expressed in Table IV.

TABLE IV.—*Examination of Boston Sewage, Summer Street Sewer.* (Results expressed in Parts per 100,000.)

Number.	DATE.	Solid Residue of— Filtered Sewage.	Solid Residue of— Unfiltered Sewage.	Suspended matters, by Difference.	Ammonia.	Albuminoid Ammonia.	Nitrogen as Nitrites and Nitrates.	Chlorine.	Remarks.
50	Wednesday, Sept. 18, 10.00, A. M.,	60.00	93.50	33.50	3·00	0.50	0.005	24.0	Equal amounts of Nos. 50, 51, 53, 54, gave 0.4094 parts phosphoric acid.
51	" " 18, 12.00, M.,	71.00	96.00	25.00	4.00	0.70	*	23.2	It began to rain on Sept. 18, at 1.45 P. M.
52	" " 18, 2.00, P. M.,	41.80	424.50	382.70	2.00	0.30	0.012	14.4	0.0447 Phosphoric acid.
53	" " 18, 4.00, P. M.,	44.50	73.80	29.30	4.10	0.45	–	16.0	The rain ceased before 4, P. M.
54	" " 18, 6.00, P. M.,	68.00	89.00	21.00	4.50	0.55	–	21.6	– –
55	Monday, " 23, 6.00, A. M.,	85.50	115.30	29.80	3.00	0.50	0.081	36.0	– –
56	Wednesday, Oct. 2, 7.30, A. M.,	95.20	143.40	48.20	4.90	0.55	0.042	42.0	– –
57	" " 2, 9.30, A. M.,	78.60	126.00	47.40	5.10	0.50	–	33.0	– –
58	" " 2, 11.30, A. M.,	48.60	80.20	31.60	5.40	0.63	0.042	16.0	– –
59	" " 2, 1.30, P. M.,	47.50	70.80	23.30	5.70	0.63	0.062	16.0	– –
60	" " 2, 3.30, P. M.,	49.60	85.60	36.00	5.00	0.55	0.059	13.0	– –
61	Saturday, " 12, 8.00, P. M.,	27 50	28.20	0.70	2.00	0.42	0.021	9.0	– –
62	" " 12, 10.00, P. M.,	20.70	45.60	24.90	2.50	0.38	0.017	5.0	– –
63	" " 12, 12.00, P. M.,	18.30	23.10	4.80	1.80	0.22	0.009	5.0	– –
64	Sunday, " 13, 2.00, A. M.,	16.50	–	–	0.75	0.20	0.043	4.0	– –

65	Sunday, Oct. 13, 4.00, A. M.,	12.60	14.60	2.00	0.28	0.13	0.050	4.0	–	–
76	" " 13, 6.00, A. M.,	13.50	13.80	0.30	0.25	0.17	0.025	3.2	–	–
	Average of 33 day samples, . .	58.96	96.30	37.34	2.72	0.73	–	18.94	1.69 Phosphoric acid. Mean of 19 samples.	
	Average of 4 night samples, .	17.00	27.7	7.9	1.33	0.23	–	4.50	–	–

* Considerable.

NOTE.—It will be noticed in this and the following tables, that in many of the samples of sewage we have determined the amount of nitrogen, existing as nitrates or nitrites. These determinations are of interest because our experience, in this respect, differs from that of the English authorities who say that the sewage contains no nitrogen in this form. We find that whether the sewage be allowed to remain in stoppered bottles, or be exposed to the air, the amount of nitrates (or nitrites) increases quite rapidly. The amount of nitrogen existing in this form was determined by the modified aluminum process.

In endeavoring to express in some sense the average composition of the sewage, we have preferred to exclude those samples taken from the lower part of the city, where sugar-refineries and other manufactories are situated, for the reason that any scheme for the treatment of the sewage would probably involve special arrangements with reference to the waste from such sources. The Summer Street sewer may be regarded as standing midway, as far the sewage is concerned, between the thickly settled North End, and the less thickly inhabited districts of the South End: the results of the examination of the sewage of this locality are particular important.

If we refer to Tables II. and III., we see that, as a rule, the sewage is much weaker than the "average sewage" of the Rivers Commission (see Table I.). Taking the ammonia as an index, their average sample contains 5.557 parts in 100,000, and the minimum amount found in any sample from water-closet towns was 2.030 parts. In the Boston sewage, on the contrary, the largest amount found upon any one occasion was 5.70 parts, and the amount as a rule was very much less. The average of thirty-three day samples shows 2.725 parts of ammonia, and the average of the four night samples shows 1.330 parts: these statements are presented in tabular form as follows:—

Ammonia in parts per 100,000.

Rivers Commission average,	5.557
Maximum in samples from midden towns,	0.380
Minimum,	30.350
Maximum in samples from water-closet towns,	25.960
Minimum,	2.030
Boston sewage, average of thirty-three day samples,	2.725
Boston sewage, average of four night samples,	1.330
Maximum,	5.700
Minimum of day samples,	0.210

We should expect that the sewage of Boston, would be weaker than that of English towns and cities, from the fact that the water-supply is used much more lavishly in household operations.

If we accept the averages in Table IV. as actually representing the average composition of Boston sewage in ordinary weather, what value shall we assign to it?

Gaugings made by the Cochituate Water Board at various times, would seem to justify us in stating the average hourly consumption of water by night, to be about one-third that by day. Making allowances for this fact, and taking the above averages as a basis of calculation, we should say that the value of the sewage was about 1.88 cents per ton.*

It is to be noted, that in making up the averages, most of the samples were of dry-weather sewage, so that this value is far too large, if we take into account the rain-water which finds its way to the sewers. Compare, for instance, Nos. 51 and 52. The marked decrease in the strength of the sewage in the second instance, is due to the fact that a heavy shower occurred shortly before the taking of No. 52; the shower had subsided before No. 53 was taken.

Of all the day samples thus far examined, the one which contained the most ammonia would be worth 3.44 cents per ton; that containing the least ammonia would be worth 0.679 cent per ton.

Although the examination of a larger number of samples might lead to results which would alter somewhat the averages on which we have based our calculations, yet they are probably near enough to the truth to answer our present purpose. The average value of the sewage could hardly be more than one cent a ton, and although the aggregate value of the sewage seems great, there has as yet been devised no plan by which the money value could practically be recovered from it. Our own conclusions may be very well stated, in the words of the superintendent of sewers, as expressed in his Annual Report for 1871:—

"To utilize by irrigation the dry-weather sewage only of Boston, would require its collection by a large encircling sewer, the raising of 100,000 tons of water daily, to the height of twenty or thiry feet, the construction of a covered channel, sufficient for its carriage to a suitable district, and its continuous discharge upon a farm of 2,000 acres. What should be done with the

* There is no universally adopted method of estimating the value of the fertilizing ingredients of such a substance as sewage. In our calculations, we have reckoned the ammonia at 25 cents per lb., the "albuminoid ammonia" at 20 cents, and the phosphoric acid at 10 cents.

storm-water drainage (often the most valuable, but requiring ten times the provision necessary for dry weather)*; where to find the necessary farm within a reasonable distance, where land is not constantly growing in value for building sites; and what to do with the works during the four winter months, when the ground is frozen and the whole system inoperative, are questions that would precede any attempt to estimate the cost or the return from such a project."

Sewage of Worcester.—The admirable system of sewerage which Worcester possesses, has already been somewhat described; at present, the whole of the sewage entering the sewers is discharged into Mill Brook; eventually a small portion will be discharged on the other side of the city, into what is known as Beaver Brook. Mill River rises in the north-east part of Holden, and before reaching the city it drains an area of some 7.8 square miles, mostly farming country. Worcester has an abundant water-supply, the daily consumption being estimated to average 3,000,000 gallons. Many buildings which have no connection with the sewers are supplied with water, and the average dry-weather sewage is estimated at 1,500,000 gallons per day. (See Mr. Ball's Report in the Appendix.) Mill Brook having received this sewage in addition to the refuse of some manufacturing establishments, is about doubled in volume, and flowing below the city, joins the larger and purer Kettle Brook to form the Blackstone River. Our examination of the Blackstone River, as will appear subsequently, showed that as yet the amount of impurity carried in by Mill Brook is insufficient to very seriously interfere with the use of the river-water, except as a souce of water-supply; still it is to borne in mind that the sewage is increasing from year to year in amount and in strength, and a very dry season might even now cause the river to be offensive, as far down as at Blackstone. The day may not be in very remote future, when the legitimate use of the river in manufacturing operations may call for an injunction upon its use as a carrier of sewage. In such an event, would it be possible to purify the sewage, so that it might be

* Our examination would seem to show that in the case of Boston, the storm-sewage is very much weaker than the dry-weather sewage: the abundant use of water tends to keep the sewers clean, and to prevent the accumulation of organic matter to be washed away when the sewers are flushed by a heavy shower. The suspended matter in the storm samples consisted largely of street wash, containing a considerable proportion of sand, and being of little agricultural value.

run into the river without causing a nuisance? This question is one of greater interest, from the fact that Worcester is an example of an inland town, the liquid refuse of which must ultimately find its way to some water-course. Of such towns, there are many in our State, already furnishing themselves with a more or less complete system of water distribution, and a system of sewerage follows in natural order. The problem is, moreover, one which must soon press for solution upon the larger inland cities of other States.

In the case of Worcester, we do not hesitate to say, that a scheme for the treatment of the sewage is practicable. At the request of the Secretary of the Board, Mr. Phinehas Ball, civil engineer of Worcester, has prepared a statement of a plan which he has had in his own mind, by which the sewage may be collected and conveyed to a point below the city, where there is an abundance of land suitable for the arrangement of filtering beds on the large scale, or where the sewage might be employed for purposes of irrigation. But, of course, the question immediately suggests itself, what could be done during the winter months. In England it has been found possible to run the sewage upon fallow land throughout the winter; in fact, the temperature of the sewage itself is some degrees above the freezing point, and prevents the ground from freezing. In our climate there would, however, be some months, not more than four, in which it would hardly be possible to cleanse the sewage by filtration; during that time a less efficient means of purification might be adopted; namely, this: to the sewage at Worcester, add a quantity of lime and clay, as recommended by Gen. Scott (see p. 57), and allow the sewage to settle in basins at the point where the sewage is in summer run upon the land. The surface of the water in the settling-basins might be frozen over, but the sewage would enter beneath the ice, the flocculent sludge would settle, and the clarified liquid might then be discharged into the river. Although the sewage thus clarified would still be liable to putrefaction, the low temperature of the air and of the water would prevent the river from becoming offensive. The sludge might accumulate to a certain amount and then be removed, dried and burned to cement. There would probably be no difficulty in removing the sludge from

time to time, especially if the settling tanks were somewhat protected from the weather, for the temperature of the sewage is so much higher than that of the surrounding air, that Mill Brook, into which it is discharged, does not freeze in winter. It may further be said that it probably would be found advisable to treat the sewage with lime, or with lime and clay, throughout the summer as well, before running it upon the land.

Having thus shown that there is no insuperable obstacle in the way of the sufficient purification of the sewage of Worcester, the question arises, Could there be expected any return from the large outlay that would necessarily be involved? In this connection it is desirable to ascertain what is the approximate value of the Worcester sewage at present. To aid in in forming some estimate, we have analyzed a considerable number of samples of the liquid from the three most important sewers, the samples being taken systematically at stated hours. The sewage was collected under the direction of Mr. R. H. Chamberlain, superintendent of sewers. Weirs were introduced into the sewers and the flow of water at the time of sampling was in each case observed.

Of the sewers chosen, the Southbridge-street sewer receives the sewage of about 429 acres, occupied mostly with dwelling-houses. The Front-street sewer drains forty-four acres, compactly covered with stores and dwelling-houses in about equal proportion. The Thomas-street sewer drains a similar district of some twenty-five acres. The sewers receive subsoil water, but during the time the samples were taken, the cold weather kept the surface water very completely from the sewers, and these samples may be regarded as affording a fair average of the dry-weather sewage.

The results of the examination are given in the following table :—

TABLE V.—*Examination of Worcester Sewage.* (Results expressed in Parts per 100,000.)

Number.	DATE.	Flow in gallons per second.	SOLID RESIDUE OF— Filtered Sewage.	Unfiltered Sewage.	Suspended matters, by Difference.	Ammonia.	Albuminoid Ammonia.	Chlorine.	Nitrogen as Nitrites and Nitrates.	Remarks.
	Southbridge-street Sewer.									
105	Wednesday, Nov. 20, 6, A. M.,	16.7	19.0	22.0	3.0	0.35	0.075	3.2	0.276	– –
106	" " 20, 9, A. M.,	17.3	22.5	30.0	7.5	1.00	0.225	3.6	0.284	– –
107	" " 20, 12, M., .	17.3	24.5	32.5	8.0	1.00	0.300	4.4	0.132	– –
108	" " 20, 6, P. M.,	16.7	22.8	34.1	11.3	0.65	0.250	3.2	0.255	– –
109	" " 20, 9, P. M.,	16.4	17.4	23.6	6.2	0.30	0.079	2.8	0.235	– –
110	" " 20, 12, P. M.,	15.4	18.8	21.0	2.2	0.25	0.075	2.8	0.227	– –
111	Tuesday, " 26, 6, A. M.,	14.2	6.7	10.0	3.3	0.50	0.075	2.2	0.225	– –
112	" " 26, 9, A. M.,	17.7	21.7	60.2	38.5	1.50	0.213	4.0	0.029	– –
113	" " 26, 12, M., .	17.7	17.5	40.8	33.3	1.00	0.125	3.6	0.032	– –
114	" " 26, 6, P. M.,	17.3	19.3	41.1	21.8	0.65	0.087	3.6	0.115	– –
115	" " 26, 9, P. M.,	15.7	7.5	11.5	4.0	0.48	0.077	2.4	0.143	–
116	" " 26, 12, P. M.,	14.8	18.2	21.2	3.0	0.30	0.062	2.8	0.338	– –
123	" Dec. 3, 6, A. M.,	14.2	18.2	25.9	7.7	0.95	0.070	2.8	0.383	0.0426 Phosphoric acid. Mean of 123, 127 and 128.
124	" " 3, 9, A. M.,	17.7	27.0	55.3	28.3	0.96	0.380	3.2	0.075	– –
125	" " 3, 12, M., .	18.0	26.0	51.8	25.8	0.80	0.213	4.0	0.048	– –
126	" " 3, 6, P. M.,	15.7	21.5	36.1	14.6	0.90	0.175	4.0	0.233	– –
127	" " 3, 9, P. M.,	15.4	18.1	22.4	4.3	0.53	0.050	3.2	0.315	– –
128	" " 3, 12, P. M.,	15.1	19.1	20.7	1.6	0.52	0.050	2.4	0.356	– –

TABLE V.—Concluded.

Number.	DATE.			Flow in gallons per second.	Solid Residue of— Filtered Sewage.	Unfiltered Sewage.	Suspended matters, by Difference.	Ammonia.	Albuminoid Ammonia.	Chlorine.	Nitrogen as Nitrites and Nitrates.	Remarks.
	Front-street Sewer.											
130	Saturday,	Dec.	7, 6, A. M.,	2.5	15.3	16.8	1.5	0.95	0.150	2.4	–	0.1212 Phosphoric acid. Mean of 130, 134, 135.
131	"	"	7, 9, A. M.,	2.8	20.1	43.5	23.4	2.50	0.400	3.6	–	0.3832 Phosphoric acid. Mean of 131, 132, 133.
132	"	"	7, 12, M.,	3.2	20.1	30.5	10.4	2.00	0.260	4.0	–	– –
133	"	"	7, 6, P. M.,	3.1	18.1	29.3	11.2	1.37	0.175	4.0	–	– –
134	"	"	7, 9, P. M.,	2.8	14.2	18.0	3.8	0.95	0.120	2.4	–	– –
135	"	"	7, 12, P. M.,	3.1	5.8	10.0	4.2	0.50	0.075	2.0	–	– –
136	Monday,	"	9, 6, A. M.,	2.8	16.8	27.5	10.7	1.10	0.300	3.2	–	0.2086 Phosphoric acid. Mean of 136, 140, 141.
137	"	"	9, 9, A. M.,	3.2	26.6	75.3	48.7	3.00	0.500	4.0	–	0.2726 Phosphoric acid. Mean of 137, 138, 139.
138	"	"	9, 12, M.,	4.7	25.8	66.5	40.7	1.50	0.400	4.4	–	– –
139	"	"	9, 6, P. M.,	3.2	18.0	30.5	12.5	1.56	0.300	4.0	–	– –
140	"	"	9, 9, P. M..	3.1	12.9	15.1	2.2	0.75	0.300	2.0	–	– –
141	"	"	9, 12, P. M.,	2.8	9.9	11.5	1.6	0.40	0.200	2.0	–	– –
142	Tuesday,	"	10, 6, P. M.,	3.9	12.5	16.9	4.4	1.25	0.140	2.4	–	– –
143	"	"	10, 9, P. M.,	3.2	13.5	13.8	0.3	0.75	0.088	3.6	–	– –
144	"	"	10, 12, P. M.,	3.2	11.4	13.5	2.1	2.75	0.950	2.4	–	– –
145	Wednesday,	"	11, 6, A. M.,	2.0	23.3	27.8	4.5	2.00	0.230	6.8	–	– –
146	"	"	11, 9, A. M.,	3.9	60.6	125.5	64.9	3.50	0.800	6.4	–	1.637 Phosphoric acid.
147	"	"	11, 12, M.,	4.0	15.7	21.2	5.5	1.80	0.200	3.2	–	– –

	Thomas-street Sewer.									
148	Monday, Dec. 16, 6, A. M.,	0.9	13.8	14.5	0.7	0.25	0.100	2.4	–	0.2046 Phosphoric acid. Mean of 148, 152, 153.
149	" " 16, 9, A. M.,	0.9	32.5	61.9	29.4	4.50	0.750	6.0	–	0.5586 Phosphoric acid. Mean of 149, 150, 151.
150	" " 16, 12, M.,	1.0	26.8	56.1	29.3	2.00	0.500	4.4	–	– –
151	" " 16, 6, P. M.,	0.8	23.7	31.0	7.3	2.15	0.300	4.8	–	– –
152	" " 16, 9, P. M.,	0.8	15.5	16.8	1.3	0.70	0.080	3.2	–	– –
153	" " 16, 12, P. M.,	0.5	16.0	17.2	1.2	0.33	0.062	2.4	–	– –
154	Tuesday, " 17, 6, A. M.,	0.8	14.2	16.9	2.7	0.40	0.045	10.8*	–	0.2046 Phosphoric acid. Mean of 154, 158, 159.
155	" " 17, 9, A. M.,	0.8	25.7	62.3	36.6	3.50	0.400	4.8	–	0.4306 Phosphoric acid. Mean of 155, 156, 117.
156	" " 17, 12, M.,	1.0	33.1	52.8	19.7	2.00	0.350	2.4	–	– –
157	" " 17, 6, P. M.,	0.8	51.6	53.9	2.3	1.50	0.163	23.2*	–	– –
158	" " 17, 9, P. M.,	0.8	23.1	25.5	2.4	1.50	0.163	7.6	–	– –
159	" " 17, 12, P. M.,	0.5	20.2	23.8	3.6	0.63	0.070	4.4	–	– –
160	Wednesday, " 18, 6, P. M.,	1.0	19.4	20.9	1.5	1.50	0.200	4.0	–	– –
161	" " 18, 9, P. M.,	0.8	18.2	21.2	2.9	1.88	0.150	3.6	–	– –
162	" " 18, 12, P. M.,	0.8	13.2	15 1	1.9	0.60	0.125	2.4	–	– –
163	Thursday, " 19, 6, A. M.,	0.8	12.4	14.3	1.9	0.50	0.075	2.0	–	– –
164	" " 19, 9, A. M.,	0.8	30.0	58.4	28.4	4.50	0.500	8.0	–	– –
165	" " 19, 12, M.,	0.8	21.4	27.4	6.0	2.05	0.225	4.4	–	– –
	Average of 27 samples, taken at 6, A. M., 9 and 12, P. M.,	–	15.29	–	–	0.745	0.144	3.1	–	0.1940 Phosphoric acid. Mean of 12 determinations.
	Average of 27 samples, taken at 9, A. M., 12, M., and 6, P. M.,	–	25.35	–	–	1.876	0.316	4.17	–	0.6564 Phosphoric acid. Mean of 13 determinations.

* These determinations are omitted in making up the averages as they are so abnormal.

For purposes of calculation we have divided the day into two parts, and have made two averages, one including the the samples taken at 6, A.M., 9 and 12, P.M., the other those taken at 9, A.M., 12, M., and 6, P.M. The averages thus calculated are introduced into the table. Reckoning the value of the sewage by the same standard as in the case of the Boston sewage, and taking into account that the flow from 9, P.M. to 6, A.M. is about eight-ninths of the flow from 9, A.M. to 6, P.M., we estimate the average value of the dry-weather sewage of Worcester to be 0.861 of a cent per ton.

It would not be possible to say how great a return could be derived from the use of such dilute sewage as this, if applied in irrigation. If the sewage were conveyed below the city to lands laid out for purposes of filtration, no doubt adjacent land might be laid out to receive portions of the sewage for application in irrigation; with the present price of labor, it is not probable that the return would equal more than a small fraction of the outlay, although the fact that the sewage could be delivered by gravitation would be a great advantage.

In regard to the amount of land which would be necessary for the purification of the sewage, it is impossible to make accurate estimates without first having made experiments upon the particular soil. It has been already stated that with soil of good quality and underdrained at a depth of six feet, the sewage of 3,300 persons to the acre may be satisfactorily purified. Worcester would thus require, if all the dwellings were connected with the sewers, an area of thirteen acres, at least. To purify the sewage by using it in irrigation would require as much probably as 1,000 acres.

For purposes of comparison we have introduced a table, comparing the average Worcester sewage with that received at various English sewage-farms, according to analyses of Dr. Letheby, made several years since.

TABLE VI.—Parts in 100,000.

DESCRIPTION.	Total dissolved matters.	Ammonia.	Albuminoid Ammonia.
Worcester, day average,	25.35	1.876	0.316
" night average,	15.29	0.745	0.144
Aldershot Farm,	77.04	10.77	1.34
Banbury "	69.81	5.44	0.40
Warwick "	67.44	3.14	0.20
Rugby "	52.38	6.33	0.23
Rugby "	61.86	5.49	0.17
Worthing "	43.33	0.34	0.11
Carlisle "	43.10	2.74	0.17
Croydon "	39.53	2.86	0.34
Norwood "	58.57	2.86	0.46

No really systematic and well-conducted efforts have, as far as we know, been made in this country to utilize sewage by irrigation. It was once attempted to distribute the sewage of the Lunatic Hospital at Worcester over some adjacent land, but there was no underdrainage, the system, such as it was, being once arranged, was left to take care of itself, and the result was understood to be unsatisfactory to all concerned.

The Effect of Sewage and Manufacturing Refuse on Running Streams.

One of the most important questions connected with the disposal of sewage-matter is the effect of draining the same into running streams. The brooks and rivers offer naturally a convenient means of disposing of such waste matters as will float down the stream, and of such as may be discharged, dissolved or suspended in water, from the surrounding territory. This is especially the case if, in accordance with the opinion expressed on previous pages, the water-supply furnishes, wherever applicable, the best means of removing the excreta and other refuse matters from the dwellings of the towns. The sewage must be disposed of somewhere, and is directed towards the nearest water-course. Nor is there wanting temptation to throw solid material into the rivers, or to allow it to accumulate on the banks, to be washed into the streams by freshets. Manufactories are located on river-

banks, partly for the sake of the water-power, partly on account of the desire to use the water in various manufacturing operations, and partly because the running stream affords an opportunity of readily disposing of the waste liquors and other refuse.

It is proposed by the State Board of Health, at a future time, to investigate more closely the nature and amount of the materials thrown into the various rivers of the Commonwealth from the manufactories on their banks, to see how far this pollution is unnecessary, and to suggest means for the preservation of the streams in a condition of as great purity as may be possible. For the purposes of this present Report, and as a preliminary to this proposed investigation, it was thought best to take a single stream, on which many factories were located, and to examine specimens of water taken from various points of its course. In order to draw perfectly satisfactory conclusions as to the amount of impurity turned into the river from towns and factories on its banks, it would be necessary to make a large number of examinations, taking samples of the water at different seasons of the year, when the river is full, and when it is low.

The Blackstone River was chosen for this investigation. This river is situated mainly in Worcester County, and on its banks are located many woollen and other mills, wire-works, etc.; moreover, it receives the entire sewage of the city of Worcester, as has been stated in a previous portion of this Report. The river is formed by the junction in South Worcester of two brooks,—Mill Brook and Kettle Brook. Kettle Brook rises in ponds in Auburn, and although it will eventually receive a portion of the sewage of Worcester, and although even at present there are a few manufactories on its banks, it may now be regarded as practically unpolluted, as will be seen from the examination below. Mill Brook, on the contrary, is a very foul stream; it rises in the north-east part of Holden, and flows through Worcester, receiving the drainage from several manufactories, and the whole sewage of the city (1,500,000 gallons daily). On the river, below the junction of the two brooks, are located the Quinsigamond iron and wire works, and from Quinsigamond village to Millbury the river flows between low banks. Between these

points there are one or two mills supplied with water from the old Blackstone Canal. In Millbury and Wilkinsonville (in Sutton) there are a number of manufacturing establishments, and the river receives accessions from several brooks and small streams. Between Saundersville and Farnumsville (in Grafton) the river is joined by a stream from Lake Quinsigamond. Thence the river flows through Northbridge and Uxbridge, in which latter town it is joined by the Mumford or Manchaug River, a stream which draws its supply from ponds in Douglas and Whitinsville (in Northbridge). South of the village of Uxbridge, the Blackstone is joined by the West River, and then flows through the town of Blackstone into Woonsocket, Rhode Island. The length of the Blackstone, from the junction of Mill Brook and Kettle Brook in Worcester to the state line, is about twenty-five miles.

The West River, which joins the Blackstone south of Uxbridge, is a stream of considerable size, which comes from the north-west part of Grafton and the northern part of Upton. Like the Blackstone, it supplies numerous factories with water and receives their drainage.

The population of the towns through which the river flows was, according to the U. S. Census of 1870, as follows:—

Auburn,	1,180
Worcester,	41,115
Millbury,	4,400
Grafton,	4,595
Sutton,	2,699
Northbridge,	3,775
Uxbridge,	3,062
Blackstone,	5,421
	66,247

The population of Woonsocket, R. I., was in 1870, 7,698 persons.

Mill Brook.—Examinations of the water of Mill Brook above and below the city of Worcester, were made at various times; the results are presented in the following table:—

TABLE VII.—*Examination of Mill Brook, Worcester.* (Results expressed in Parts per 100,000.)

Number.	LOCALITY.	Flow in Cubic Feet per second.	SOLID RESIDUE OF— Filtered Water.	SOLID RESIDUE OF— Unfiltered Water.	Suspended Matters, by Difference.	Ammonia.	Albuminoid Ammonia.	Chlorine.	Nitrogen as Nitrates and Nitrites.	Remarks.
9	Above sewers, ...	–	11.98	–	–	0.815	0.543	–	–	0.0597 Phosphoric acid.
14	" "	–	5.50	6.00	0.50	0.476	0.442	0.5	–	0 " "
15	Below sewers, ...	–	8.60	11.00	2.40	0.102	0.034	1.9	–	0.0255 " "
16	Above sewers, ...	–	11.00	11.50	0.50	0.544	0.884	0.5	–	Trace " "
17	Below sewers, ...	–	10.50	14.00	3.50	1.360	2.006	2.0	–	0.0512 " "
77	Above sewers, Oct. 15, 9.30, A. M.,	44.28	6.80	9.60	2.80	0.063	0.030	1.2	0.025	– –
78	" " " 15, 1.30, P. M.,	44.69	4.00	6.50	2.50	0.100	0.037	1.6	0.029	– –
79	" " " 15, 6.00, P. M.,	47.96	55.30	61.50	6.20	0.033	0.030	–	0.050	Large amount of sulphate of iron.
80	Below sewers, " 15, 9.15, A. M.,	29.22	11.50	19.20	7.70	0.150	0.065	3.6	0.111	– –
81	" " " 15, 2.10, P. M.,	37.32	6.80	11.50	4.70	0.225	0.055	2.0	0.073	– –
82	" " " 15, 5.30, P. M.,	31.59	13.50	16.20	2.70	0.150	0.050	4.0	0.140	– –
83	Above sewers, " 17, 9.20, A. M.,	40.46	7.80	–	–	0.063	0.025	1.2	0.029	– –
84	" " " 17, 2.15, P. M.,	41.61	8.00	–	–	0.015	0.025	1.2	0.027	–
85	" " " 17, 5.40, P. M.,	40.29	6.50	–	–	0.020	0.030	0.8	0.037	– –
86	Below sewers, " 17, 8.45, A. M.,	32.44	20.90	–	–	0.300	0.040	2.8	0.142	– –
87	" " " 17, 2.45, P. M.,	39.21	7.70	–	–	0.280	0.075	4.0	0.140	

88	Below sewers, Oct. 17, 6.00, P. M.,	42.35	9.70	–	–	0.200	0.030	2.0	0.074	–	
93	Above sewers, " 29, 8.30, A. M.,	16.17	24.60	–	–	0.055	0.035	6.8	0.029	–	–
94	" " " 29, 12.30, P. M.,	17.91	13.00	–	–	0.050	0.050	0.8	0.053	–	–
95	" " " 29, 5.10, P. M.,	25.24	17.80	–	–	0.130	0.030	1.6	0.045	–	–
96	Below sewers, " 29, 9.00, A. M.,	22.91	15.80	–	–	0.500	0.070	2.8	0.084	–	–
97	" " " 29, 12.00, P. M.,	24.00	21.40	–	–	0.300	0.050	2.4	0.070	–	–
98	" " " 29, 6.00, P. M.,	28.79	16.50	–	–	0.200	0.050	2.8	0.070	–	–
	Above sewers, av'ge of 12 samples,	–	15.71	–	–	0.197	0.180	1.62	–	–	–
	Below sewers, av'ge of 11 samples,	–	14.90	–	–	0.343	0.229	2.74	–	–	–

As all the sewage of Worcester drains into the brook, it was at first thought that it might be possible to make some approximate calculations as to the amount of polluting matter, by a comparison of the water of the brook above and below the city. Owing, however, to the intermittent use of the water by manufactories, and to the nature of the bed of the stream, it was found impossible to draw conclusions from these examinations; the results obtained, however, show the character of the stream which below the city is practically an open sewer.

Blackstone River.—The examination of the river itself was made at two separate times. On September 28 we visited Blackstone and followed the course of the river to Worcester. The day preceding there had been a heavy rain, and the river was quite full, as indeed it has been throughout the season. Samples of the water were taken at various points. The river below Blackstone was somewhat colored but quite clear, there being no more color than would be naturally expected in the case of a river flowing as this river does for a considerable part of its course between low banks covered with grass and trees. There was no particular odor or disagreeable taste. It was stated by the hostler at one of the stables, that the water was used in watering horses and cattle. At other points of the river the water was very similar in appearance. The samples were taken from the following points:—

No. 66. Blackstone River near Rhode Island line, beyond Blackstone.

No. 67. Blackstone River between Millville (in Blackstone) and Uxbridge, where the road crosses the river on a wooden bridge. The mills at Millville are not now running.

No. 68. Blackstone River at Uxbridge near the woollen mill of Robert and Jacob Taft.

No. 70. West River. Beyond Uxbridge and below Wheelock's Woollen Mill.

No. 71. Manchaug (or Mumford) River at Uxbridge at the bridge near the Station on the Providence and Worcester Railroad.

No. 72. Blackstone River at Northbridge Station. Just below a large cotton factory.

No. 73. Quinsigamond River, a short distance above its junction with the Blackstone.

No. 74. Blackstone River in Saundersville (Grafton), just before it joins the stream from Lake Quinsigamond.

No. 75. Blackstone River just below Millbury Village.

The upper part of the river was subsequently visited on November 8th. Heavy rains had fallen for several days previous and the river was very full. Samples were taken at several points as follows :—

No. 103. Blackstone River at Millbury, at bridge just below the railroad station.

No. 102. Blackstone River at railroad bridge, a few rods above the station.

Between Nos. 102 and 103 there is a dam and a factory. The water as it flowed over the dam was seen to be quite turbid and considerably colored. In *appearance* the river on the occasion of both visits was the worst at this point.

No. 101. Blackstone River at the stone bridge near the Quinsigamond Iron and Wire Works, Quinsigamond Village, Worcester.

No. 100. Kettle Brook just before it is joined by Mill Brook.

No. 99. Mill Brook just before it unites with Kettle Brook.

The results of the chemical examination of the waters collected at the times of the several visits are given in the following table, together with the results of the examination of two specimens (Nos. 104 and 122) received at later dates from Dr. Geo. E. Bullard, correspondent of the Board at Blackstone.

No. 104. This sample was taken from the same locality as No. 66, November 18, 1872.

No. 122. This sample was taken below Woonsocket, in Rhode Island, the afternoon of December 3.

TABLE VIII.—*Examination of Blackstone River.* (Results expressed in Parts per 100,000.)

Number.	LOCALITY.	Dissolved matters.	Suspended Matters.			Ammonia.	Albuminoid Ammonia.	Chlorine.	Nitrogen as Nitrites and Nitrates.	Date of Sample.
			Mineral.	Organic.	Total.					
99	Mill Brook, Worcester,	12.30	2.02	1.55	3.57	0.1580	0.1200	2.00	0.1730	Nov. 8.
100	Kettle Brook, Worcester,	6.50	0.65	0.63	1.28	0.0120	0.0250	T e.	0.0170	"
101	Blackstone River, Worcester,	8.00	1.60	–	–	0.0450	0,0400	0.80	0.0188	"
102	" " Millbury,	5.00	1.10	0.10	1.20	0.0450	0.0400	1.20	1	"
103	" " "	5.70	1.10	0.37	1.47	0.0370	0.0250	1.20	0.0900	"
75	" " "	7.08	–	–	–	0.0340	0.0252	0.65	0.0477	Sept. 28.
74	" " Saunderville,	6.24	–	–	–	0.0192	0.0232	0.50	0.0467	"
73	Quinsigamond River,	3.40	–	–	–	0.0040	0.0216	0.25	0.0199	"
72	Blackstone River, Northbridge,	6.68	–	–	–	0,0120	0.0224	0.30	0.0436	"
71	Manchaug River, Uxbridge,	4.20	–	–	–	0.0052	0.0212	0.28	0.0137	"
70	West River, Uxbridge,	3.84	–	–	–	0.0040		0.02	0.0190	"
68	Blackstone River, Uxbridge,	5.68	–	–	–	0.0056	0.0224	0.22	0.0292	"
67	" " "	5.08	–	–	–	0.0032	0.0200	0.30	0.0127	"
66	" " Blackstone,	4.80	–	–	–	0.0032	0.0192	0.23	0.0240	"
104	" " "	6.50	–	–	0.50	0.0650	0.0350	0.60	0.0199	*Nov. 18.
122	" " Woonsocket,	[illegible]0	–	–	0.60	0.0[illegible]00	0.0250	0.20	0.0395	*Dec. 3.
129	Boston water supply, Nov. 20, 1872,	8.00	–	–	–	0.0080	0.0160	0.50	0.020	–
	" " " Dec. 12, "	5.28	–	–	–	–	–	–	–	–
	" " " Dec. 17, "	5.24	–	–	–	–	–	–	–	–

* Two liters of each, 104 and 122, evaporated to small bulk failed to give indications of arsenic, which is often found in appreciable quantities in the rivers of England which drain manufacturing districts.

In this table the samples are arranged according to the localities from which they were taken, proceeding from the head-waters toward the mouth of the river. An inspection of the tables shows that the condition of the river is not as bad as might be expected from the number of manufacturing establishments upon its banks. Although one of the streams which unite to form the river is extremely foul (being, in fact, dilute sewage), yet we find that the amount of impurity from this and other sources which remains in the river, by the time it reaches Blackstone is very small, compared with the bulk of water. It is to be remarked, that the examination was made at a time when the river was quite full, and after a wet season. No doubt there would be found, during a hot and dry summer, an increased amount of impurity. We are informed by Dr. Bullard, that at Blackstone the water is drunk by horses, and that stable-men have noticed no material change in the river for fifteen years, except during the summer of 1871, when the river was low; at that time the water was not fit even for horses to drink. For the sake of comparison, there are inserted in the table the results of the examination of the water supplied to the city of Boston, as drawn from the pipes in the laboratory of the Institute of Technology, November 20, 1872.

Merrimac River at Lowell.—In addition to the examination of the Blackstone River and its tributaries, as already detailed, a single suite of specimens from the Concord and Merrimac Rivers at Lowell has been analyzed. The samples were taken Saturday afternoon, November 30, 1872. The day was a very cold one, and ice was forming on the sides of the streams. The rivers were not as full as a few weeks previously, but yet they were quite full. The following table shows the results of the analyses :—

TABLE IX.—*Examination of Merrimac River at Lowell.* (Results expressed in Parts per 100,000.)

Number.	LOCALITY.	Solid Residue of— Filtered Water.	Solid Residue of— Unfiltered Water.	Suspended Matters, by Difference.	Ammonia.	Albuminoid Ammonia.	Chlorine.	Nitrogen as Nitrates and Nitrites.	Remarks.
117	Merrimac River, above dam, at entrance of new canal, . .	2.60	3.10	0.50	0.030	0.035	0.16	0.0096	– –
118	Concord River, at 7-arch bridge, near cemetery. . . .	2.60	4.40	1.80	0.020	0.050	0.30	0.0082	– –
119	Concord River, East Merrimac Street Bridge (just before junction with Merrimac), .	5.10	5.70	0.60	0.023	0.043	0.34	0.0216	Tested for nitrites, the waters ranged themselves in this order: 117, 121, 119, $\overbrace{118, 120}$.
120	Merrimac River (above Central Bridge, just before junction with Concord River), .	3 60	5.40	1.80	0.025	0.050	0.17	0.0096	Tested for sulphates, Nos. 119 and 121 gave a distinct reaction; the others gave only a very faint reaction.
121	Merrimac River, 3 miles below Lowell, ...	4.50	6.20	1.70	0.022	0.024	0.30	Trace.*	– –
129	Boston water, Nov. 20, 1872, .	8.00	–	–	0.008	0.016	0.50	0.0200	– –
	Boston water, Dec. 12, 1870, .	4.20	–	–	–	–	–	–	– –

* Amount undetermined.

It would thus appear that for the present, the rivers of Massachusetts are not polluted to such an extent as to cause alarm, and yet neither the Blackstone River nor the Merrimac below Lowell would be recommended as a source of supply for a city. It is, however, to be borne in mind, that our manufactures and, consequently, the population of our manufacturing towns, are rapidly increasing, and that in the case of the larger towns, more efficient systems of water-supply and of sewerage are being rapidly introduced. The day is probably far distant, when we shall reach the state of things at present existing in the manufacturing districts of England, but, in many cases, it will only be a question of time; it is hoped, however, that further examination may lead to suggestions which will tend to prevent the unnecessary abuse of running streams. It seems to us that there will be no difficulty in preserving the purity of our larger streams to such an extent that the fish will continue to live in them, that cattle will not refuse to drink their waters, and that they may serve the purposes of the manufactories on their banks. As to the employment of the water for drinking purposes, it will be shown that the lakes of the Commonwealth offer an abundant supply of potable water, and the use as a source of water-supply, of running water which has, in any part of its previous course, been contaminated with sewage is, to say the least, of questionable advantage.

In order that the present very tolerable condition of our rivers may not be regarded as affording a reasonable pretext for neglecting all attempts to preserve their present state of purity, it may not be amiss to state, with some little detail, the condition of the streams flowing through the manufacturing districts of England.

Condition of certain English Rivers.—The effect of the drainage of sewage and manufacturing refuse into the rivers of England and Scotland, has been the subject of a very thorough investigation by two Royal Commissions, appointed respectively in 1865 and 1868, and allusion has already been made to the very valuable published reports of these Commissions, "appointed to inquire into the best means of preventing the pollution of rivers."

A few quotations from these reports will show the extent to which a densely-settled manufacturing country may pollute its running streams. Personal observation of some of the streams mentioned below has convinced us that the matter has in no whit been overstated. Take, for example, the rivers Aire and Calder in the West-Riding of Yorkshire. This district includes the large manufacturing towns of Leeds, Bradford, Huddersfield, etc. The area of the basin of the two rivers is 508,160 statute acres, and the population in 1861 was 943,677, or about 1,200 to the square mile. The sewage of Leeds alone, amounts to eight or ten million gallons daily. Of these rivers the Commissioners say:—

"The rivers Aire and Calder, and their tributaries, are abused by passing into them hundreds of thousands of tons per annum, of ashes, slag and cinders from steam-boilers, furnaces, iron-works and domestic fires; by their being made the receptacle, to a vast extent, of broken pottery and worn-out utensils of metal, refuse brick from brickyards and old buildings, earth, stone and clay from quarries and excavations, road-scrapings, street-sweepings, etc.; by spent dye-woods and other solids used in the treatment of worsteds and woollens; by hundreds of carcases of animals, as dogs, cats, pigs, etc., which are allowed to float on the surface of the streams, or putrefy on their banks; and by the flowing in, to the amount of very many millions of gallons per day, of water poisoned, corrupted and clogged by refuse from mines, chemical works, dyeing, scouring and fulling worsted and woollen stuffs, skin-cleaning and tanning, slaughter-house garbage, and the sewage of towns and houses."—(Third Report of the Commissioners appointed to inquire into the best means of preventing the pollution of rivers. [Rivers Aire and Calder.] 1867. Vol. I., p. xi.)

Many of the forms of pollution mentioned in this extract, such as ashes and broken pottery, could, without difficulty, be kept out of the streams: the great temptation is, of course, to run into the rivers such refuse as is already in solution, or in suspension in water. The effect of all this pollution of the rivers (leaving out of account the solid material which accumulates so as to obstruct navigation), is to render the rivers not only unfit for drinking and for other domestic purposes, but also to injure them for manufacturing uses, and to offend the senses and injure the health of the dwellers upon the banks, and to render them entirely uninhabitable by fish.

Take the case of Bradford.

"Bradford is an ancient town, situated on a 'beck' about four miles south of the river Aire, into which the water of this beck falls. It is the centre of

the worsted district. The population of the borough increased from 103,000 in 1851 to 106,000 in 1861, but the increase in the value of goods manufactured was enormously in excess of the increase of population. The contamination of the streams has increased, rather according to the growth of the trade, than with the increase of local population. There is increased pollution from dye-works, from soap-suds and from refuse of various kinds produced in manufactures. The whole of the sewage of Bradford and of the populous district above the town flows into the beck, producing an indescribable state of pollution. It has become a Yorkshire proverb of comparison for any foul stream to say of it, that it is as polluted as Bradford Beck. At the time of our inquiry, Bradford Beck was the source of supply of the Bradford Canal, the fluid of whch became so corrupt in summer that large volumes of inflammable gases were given off, and although it has usually been considered an impossible feat 'to set the River Thames on fire,' it was found practicable to set the Bradford Canal on fire; as this at times formed part of the amusement of boys in the neighborhood. They struck a match, placed on the end of a stick, reached over, and set the canal on fire, the flame rising six feet high and running alone the surface of the water for many yards, like a will-o'-the-wisp; canal boats have been so enveloped in flame as to frighten persons on board."

"The injury inflicted by the river pollutions of these and other towns to the estates of many riparian owners is very great; streams which in the memory of men now living were comparatively pure and well stocked with fish, are now black and stinking.

"The land through which such polluted streams flow is ruined for residential purposes, and is injured and reduced in value even for mill purposes; the water is so bad as to be considered unfit for manufacturing uses, and other sites are selected where water can be obtained from canals, or by sinking wells and boring. In many instances cattle will not drink the local river-water, and farms are depreciated in consequence.

"Large country-houses which formerly, with their river-frontage, rights of fishing, and ornamental gardens and pleasure grounds, were valued as residences, have been abandoned, or are let merely at farming rents and for farm purposes.

"The cattle plague prevailed to a great extent in the Thorp Hall meadows below Leeds, and on lands bordering foul rivers in other districts.

"This fatal disease was considered by the tenants and riparian proprietors to have been aggravated by the foul state of the water, and by the tainted atmosphere caused by river pollutions. The towns are poisoned in some degree by their own sewage and cess-pool matter, and are taxed to a considerable extent to remove this putrid refuse in a most barbarous manner. Manufacturers pollute the water for each other until the streams have to be abandoned for all but the coarsest purposes of trade, and clean water has to be purchased from water-works companies, or must be sought at great cost in well-sinking and boring, to which must be added the charges for extra steam-power. In some cases the manufacture and dyeing of finer sorts of goods have been necessarily abandoned, and in other cases extension of manufacture is rendered impossible, because there is no additional volume of clean water to be obtained in the district."*

* Rivers Pollution Commission, Third Report. 1867. pp. xxxviii and xlii.

The Rivers Commission in their report present a very striking "fac-simile of a memorandum written with the water of the river Calder, taken at the point where the Wakefield sewer joins the river." The fac-simile appears as if written with ink, a trifle pale perhaps, but still very distinctly legible. The writer dedicates what is written "without permission" to the Board of Health of Wakefield, and says, "Could the odor only accompany this sheet it would add much to the interest of this memorandum."

These rivers which have been mentioned are not the only ones polluted: the same condition of things exists throughout the manufacturing districts. In the Lancaster district, the river Irwell, which flows into the Mersey, has a drainage-area of about 312 square miles with a population in 1861 of 3,255 to the square mile. Near its source "it is of excellent quality for all domestic purposes." It flows, however, through the midst of a manufacturing district; and finally passes through Manchester before it empties into the Mersey. At Manchester the sluggishly flowing stream is black as ink and is there joined by the Irk and Medlock, streams not less polluted than itself. The Commissioners say:—

"Between the mouth of the Irk and the weir at Throstlenest, there are no fewer than fifty-one different manufacturing establishments on the banks of the Irwell itself, in addition to all the others scattered about the town and on the banks of the various rivers and streams, all discharging themselves eventually into the Irwell. This enumeration of the factories both in Manchester and elsewhere on the banks of the Irwell itself, is however a very imperfect illustration of the manufacturing industry of this river-basin generally; for we learn from statements made with regard to the water-supply, that, in addition to those which have independent resources, there are no fewer than 10,500 factories and works of all kinds within the Irwell basin, which are supplied from the water-works of Manchester, Bolton, Bury, Bacup, Heywood, and Oldham alone.

"The population congregated on both sides of the river in the city of Manchester and the borough of Salford exceeds 500,000, and a rapid addition is being made to this number. Large sums of money have been expended upon public works of various kinds; and a system of sewerage has been carried out by which the ordinary drainage of both towns passes into one or other of the streams which intersect them, and finds its way ultimately into the Irwell. This drainage consists, in the first place, of the rainfall over an area of about 10,000 acres; and, in the second place, of the water brought in for the supply of the inhabitants, which, estimated at the rate of twenty gallons per individual, amounts in round numbers to 10,000,000 gallons per day. A portion of this has of course been employed for manufacturing purposes, and is passed into the streams in a more or less polluted

state. The remainder reaches the sewers after use for various domestic purposes, some of it passing through privies and water-closets, and thence carrying with it large quantities of excrementitious matter."

The condition of the different streams flowing through Manchester,—the Irk, the Medlock, the Cornbrook,—and that of the Irwell, which is the recipient of all that is brought down by these streams as well as of much which is passed directly into it by the sewers, being such as has been described, it is no wonder that the authorities of Salford (a suburb of Manchester) say: "The condition of the river is indirectly a source of ill-health and discomfort, and the condition of certain open water-courses acts in a direct manner on the health and comfort of the district." A stranger visiting Manchester and observing the Irwell winding through the parks in the suburbs of the city, would hardly think of this river, which but for its stygian aspect would be a thing of beauty in the landscape, that it had once flowed an unpolluted stream inhabited by fish.

In Scotland in the case of many of the rivers a condition of things not much better prevails. A single quotation will suffice. It is the statement of a riparian proprietor in regard to the river Tweed:—

"The river Tweed bounds my property for about one-third of a mile. My house is situated about 250 yards above the river on a rising ground. When I first came to the place, in summer there was a slight stench, but not so very bad as to attract attention. The water was filthy when the river was very low, but of late years it has become much worse, and in summer-time now the stench of it is perfectly odious, and the color of the water at certain times, for instance on Saturday afternoons, is very bad, especially about three o'clock; it comes down blue, red and green, with masses of woollen stuff floating on it. As there is a weir at Melrose just immediately below my property, it creates a great pool in which this stuff or a considerable part of it settles. The result is that the bed of that pool has become perfectly filthy, so that if a dog goes into it, he comes out just exactly as if he had escaped from a dye-vat."

The quotations show to what extent the pollution of streams may be carried. It is, however, true that much of this pollution might be avoided, and the polluting material might even be made a source of profit; at any rate, it will, no doubt, be of importance to ascertain as soon as it can be done, in the case of all the rivers in the State, or flowing through it, to what extent polluting matters are carried into

the streams, and how far this discharge might be avoided so as to put far off the evil day. It is true that there are already some small streams in the State which are now polluted to a considerable extent: such are Mill Brook (Worcester), Stony Brook (Roxbury), Neponset River and a brook visited several years ago in Melrose. These streams resemble some of the smaller English rivers: they seem hopelessly polluted; there is, however, no question but that the condition of even these streams might be improved, although such purification would be attended with considerable expense.

Alleged Self-Purification of Running Streams.

It is a wide-spread popular idea, that no matter how much impurity is discharged into a running stream, yet by flowing a dozen miles or so, the stream will for all practical purposes free itself from the impurity and become fit for use even as a source of water-supply. It has been alleged that the organic matter is almost completely oxidized by the oxygen of the air and by that dissolved in the water, and that this oxidizing action is very much increased, if the water be agitated by passing over weirs or natural falls. This feeling has gained considerable currency and has been held by some men who are looked to as authorities, such as Dr. Miller, Dr. Odling and Dr. Letheby: it is, however, unsupported by direct proof; in fact, the experimental evidence leads us to the contrary opinion. The Rivers Pollution Commission made this question the subject of direct investigation, and showed very conclusively that the commonly received opinion was erroneous. They chose localities on several streams where the rivers, in each instance, flowed for almost a dozen miles without receiving additional pollution, and determined the amount of organic matter destroyed. They also made mixtures of ordinary sewage with different quantities of water, and in these artificial mixtures, which were, by various devices, exposed to the free action of the oxygen of the air, they determined the rate at which the organic matter disappeared. This they did by estimating from time to time the organic nitrogen and carbon contained in the solution; also by observing the rate at which the dissolved oxygen

disappeared. As a result of these experiments they affirm that,—

"It is evident, that so far from sewage mixed with twenty times its volume of water being oxidized during a flow of ten or twelve miles, scarcely two-thirds of it would be so destroyed in a flow of 168 miles at the rate of one mile per hour, or after the lapse of a week. In fact, whether we examine the organic pollution of a river at different points of its flow, or the rate of disappearance of the organic matter of sewage when the latter is mixed with fresh water and violently agitated in contact with air, or finally, the rate at which dissolved oxygen disappears in water polluted with five per cent. of sewage, we are led in each case to the inevitable conclusion that the oxidation of the organic matter in sewage proceeds with extreme slowness, even when the sewage is mixed with a large volume of unpolluted water, and that it is impossible to say how far such water must flow before the sewage-matter becomes thoroughly oxidized. It will be safe to infer, however, from the above results that there is no river in the United Kingdom long enough to effect the destruction of sewage by oxidation.

"These results confirm the opinion arrived at from theoretical considerations, and expressed by Sir Benjamin Brodie in his evidence, given before the former Rivers Pollution Commission (First Report, River Thames, Vol. II., Minutes of Evidence, page 49). His evidence was to the following effect:—

"'I should say, that it is simply impossible, that the oxidizing power acting on sewage, running in mixture with water over a distance of any length, is sufficient to remove its noxious quality. I presume that the sewage can only come in contact with oxygen from the oxygen contained in the water, and also from the oxygen on the surface of the water; and we are aware that ordinary oxygen does not exercise any rapidly oxidizing power on organic matter. I believe that an infinitesimally small quantity of decaying matter is able to produce an injurious effect upon health. Therefore, if a large proportion of organic matter was removed by the process of oxidation, the quantity left might be quite sufficient to be injurious to health. With regard to the oxidation, we know that to destroy organic matter the most powerful oxidizing agents are required; we must boil it with nitric acid and chloric acid and the most perfect chemical agents. To think to get rid of organic matter by exposure to the air for a short time is absurd.'"

If the results of these experiments are conclusive, how does it happen that while so much foul matter is even now being poured into our rivers, that they are yet no worse? There are several things to be considered: in the first place, there is continually going on a deposition of suspended matters, and of insoluble substances formed by the chemical changes taking place in the liquid. To illustrate this subsidence from chemical change: an examination of the sample of water from Mill Brook, numbered 79 (which contained a large quantity of sulphate of iron), was made October 17; some of the water was then allowed to remain

in a closed bottle, half-filled with air. The amount of suspended or rather sedimentary matter, at first small (6.2 parts in 100,000), soon began to increase, and was of the well-known red color of oxide of iron. On November 16, a portion of the liquid was filtered, and it was found that the amount of iron in solution had decreased from 23.6 parts in 100,000 to 6.15 parts. The hydrate of iron precipitating under such conditions, drags down with it more or less organic matter, and this oxidation of the sulphate of iron and the precipitation of the hydrated oxide of iron would take place in the running stream, especially when the stream flows as the Blackstone does for considerable portions of its course, with a slight descent. At the time of our examination of the Blackstone, the river appeared most turbid and colored in the neighborhood of Millbury: at Northbridge, six or seven miles below, the river was improved in appearance, although it had passed several mills.

Again, the river is continually receiving accessions to its volume, sometimes, to be sure, from streams more or less polluted, but more often from streams as yet uncontaminated, or from lakes, the banks of which are still in their natural state. Moreover, the drainage from the high surrounding country, filtering through the earth, enters the river somewhat hard; perhaps from the presence of mineral matters held in solution, but containing only a small amount of organic impurity.

These facts alone are sufficient to account for the apparent disappearance of a large amount of organic matter, but while we do not overrate its effects, we must not fail to give due weight to the oxidation continually going on. It would seem from the experiments of the Rivers Commission, that in a flow of a dozen or twenty miles, as much as 20 or 30 per cent. of ordinary sewage-impurity might, in summer weather, be destroyed by oxidation. It must be borne in mind, however, that for all we know, the portion remaining unoxidized may be the very portion most injurious to health. If certain diseases be propagated by germs,—by living organisms,—we may well suppose that such germs would live, although dead organic matter might be destroyed. In expressing our own conclusions on this subject, we perhaps

cannot do better than quote the words of Dr. Frankland, the most eminent chemical authority on the sewage question :—

"There is no process practicable on the large scale by which that noxious material (sewage-matter) can be removed from water once so contaminated, and, therefore I am of the opinion that water which has once been contaminated by sewage or manure matter, is thenceforth unsuitable for domestic use."

The Water-Supply of Towns.

We have seen to how great an extent the streams of Massachusetts, of whatever size, whether rivers like the Connecticut and Merrimack, or brooks like Mill Brook in Worcester, or Stony Brook in Roxbury, are made carriers of waste materials. The smaller of these streams, if running through districts filled with manufacturing establishments and a crowded population, are already spoiled for use as drinking-water.*

Rivers like the Blackstone can be still used for watering horses and cattle, except in seasons whan the volume of water is much diminished by drought, but we find no towns on its banks taking the water for general use, or proposing to do so. Our largest rivers are generally regarded as not so impure as to be unfit to drink. The Merrimack water is being taken at the present time above Lowell, to be filtered through earth, and then distributed to the people of that city.† Several municipalities on the banks of Charles River have sufficient confidence in the character of its water to wish to take it for general use, and are now preparing extensive works for that purpose.

Boston has recently added the waters of Sudbury River to its former supply from Lake Cochituate. A pressing and immediate necessity in the case of Boston may justify this course, but we believe the character of the water which this

* A tannery, or wool-pulling establishment, or any other place where the *hides* of either cattle, sheep or hogs (whether separated from the body or not) are dressed and fitted for their subsequent uses, will foul a little brook so that cattle will refuse to drink from it for miles below. The waste of breweries and the waste of a crowded population have made Stony Brook in Roxbury foul and stinking. Not many years ago it was a clear stream. It is now a sewer.

† The wells of Lowell are known to be so foul that many persons now prefer to drink the river-water, taken from the canal which supplies the mills with water-power.

city has previously enjoyed, will deteriorate by the contributions of a stream running through a country which will, at no very remote day, be densely populated.

Unless legislation to prevent the pollution of streams can be better enforced in Massachusetts than in England, we may conclude that the spoiling of our rivers as sources of water-supply, is a question of time, of density of population and of their size. The little brooks will go first,—streams like Mill Brook and Stony Brook will follow,—rivers like the Blackstone, Nashua, Charles, Sudbury, Housatonic and Concord will be next in order, and their deterioration will correspond with the number of people living on their banks. The Connecticut and Merrimack will longest resist the polluting influences, by reason of the volume of their waters.

In England the greatest efforts have been made to secure the purity of streams. The case is indeed an urgent one, much more so than with us, because the streams and wells are practically the only sources of water for the large towns. In examining the English reports on the subject, no one can fail to see that the laws cannot be so enforced as to effect the desired result. The most stringent regulations are made by Parliament, at the instance of "Rivers Pollution Commissions" and "Sewage of Towns Commissions," but the rivers grow more and more foul in spite of them. The temptation to use the streams as sewers is stronger than the fear of the law which seeks to protect them.

London is compelled to use the upper waters of the Thames for the supply of her three millions of people, and under this extreme necessity, and through the coöperation of the various companies who distribute the water, no doubt a good deal of refuse is kept out of that stream. The water is filtered by the companies before being delivered through the mains, and is again filtered before use by many consumers; and after all these precautions it is obviously impure and unsatisfactory. It is a constant subject of discussion among the people, and weekly reports of its character, and of the amount of the "previous sewage contamination" which it holds are made by chemists employed by the government. There can be no doubt that the very extensive (almost universal) use of alcoholic drinks as an ordinary daily beverage

by all classes and conditions, and by both sexes in England, is due in part to the fact that water of unquestionable purity is so very difficult to obtain.*

Is it unreasonable to suppose that the same causes which have spoiled the English rivers will in time spoil ours also? The census of 1870 shows us that if the rate of increase of population in Massachusetts since 1865 is continued for twenty-five years, our whole territory will at the end of that time contain as many people to the square mile as the England of to-day. Eastern Massachusetts will of course be even more populous. Let us then be wise in time, and provide, if possible, for the future necessities of the people, by comprehensive plans which will not merely supply single towns, but the whole community of towns.

A suburban or rural village in Massachusetts may have been furnished with good water from the wells about the houses for an indefinite period, and everybody has been content. But the village becomes a town, and its population is quadrupled by manufacturing establishments. The subsoil water is unequal to the demand made upon it, and wells are sunk deeper, the shallow wells are drained, and neighbors compete with each other in cutting off the fair allowance of what justly belongs to all. While this is going on it is also observed that the water is less pure.† It is fouled by the drainage of privies, and the liquid waste thrown upon the ground. Then comes a general demand for a supply of pure water from other sources. Application is made to the legislature for liberty to tap the nearest pond, or divert the waters of any neighboring stream, which may at the time be free from obvious contamination. And under the pressure of this immediate demand for good water, little thought is given to the fact that the same causes which ruined the family well may also in time destroy the source of the town's sup-

* London water is "let on" for one or two hours of each day, except Sunday, when every householder draws at least one day's supply, which is stored in reservoirs on the premises. Such restrictions must diminish its freshness and coolness, and seriously interfere with its most healthful uses.

† The following table shows the amount of impurity recently found in certain wells in Eastern Massachusetts by Mr. S. P. Sharples, who published the results in the "American Chemist" for November, 1872. It by no means represents the general character of our wells, but shows how bad they may become by intercepting the drainage of barn-yards, privies and other sources of filth. In the case of the well at

ply. In some instances several towns on the banks of a stream seek authority to take its waters, and having taken and used them, they must carry them back again by sewers to the same stream, unless the proximity of tide-water enables them to turn the sewage into some estuary. When Waltham and Brookline and West Roxbury so use the water of Charles River, they cannot be surprised if Dedham and Natick and other growing towns above them ask for the same privilege at no distant day. One may readily see what trouble and legislation may in this way be entailed on future generations. We fear that "Charles River Conservancy Boards" will hardly succeed any better in keeping sewage from that river than similar boards have done in England.

*Lakes and "Great Ponds."**

In seeking a remedy for this inevitable difficulty in the future,—a remedy which shall be of general application, and which, if made a part of the state policy, would go very far towards furnishing the people with pure drinking-water in all coming time, we find it in rejecting the streams, and looking to the *lakes* and *great ponds* as sources of water-supply.

It would be an interesting subject of inquiry to trace the various causes, which have made the banks of our rivers the seats of industry and of population, and have left the banks of our great ponds to comparative solitude. Such considera-

Webster, it is stated that the water was sweet and pleasant to the taste, but the family using it had typhoid fever, and this circumstance led to the examination. The numbers represent grains in one United States gallon.

LOCALITY.	Inorganic Matter.	Organic and Volatile.	Total weight of Residue.
Newton,	14.12	6.53	20.65
Waltham,	17.79	7.46	25.25
Waltham,	4.66	7.60	12.26
Hyde Park,	13.12	7.98	21.10
Andover,	8.14	8.46	16.60
Taunton,	9.91	8.74	18.65
North Cambridge,	16.42	8.75	25.17
Woburn,	62.71	10.78	73.49
Newton,	19.25	13.41	32.66
Andover,	40.59	16.03	56.62
Webster,	15.81	29.00	44.81
Chelmsford,	47.25	29.16	76.41
Andover,	3.79	33.54	37.33

* Ponds are legally designated "Great" when their area exceeds ten acres.

tions do not, however, immediately concern us. It is enough to know the fact, which is full of practical interest.

One fifty-fourth of the whole territory of Massachusetts is comprised within the areas of these natural lakes, or great ponds of over ten acres in extent. They may be described as a whole, and in general terms, as basins receiving the rain and snow falling on them directly, and also upon the adjacent country and thence conducted to them either by surface-drainage, by brooks or otherwise, by percolation through the soil of their boundaries, or through springs beneath their surface.

Their waters are generally of singular purity, and this is due to their secluded position, to the geological formation of the territory which they drain, and to their action as settling basins for all extraneous matter. They are indeed reservoirs provided by nature for the health and refreshment of the people, and we greatly desire that their providential escape from contamination up to the present day should be understood, and that the need of guarding and preserving them in the future for the public benefit should be appreciated.

There is no instance of a populous town having grown up on the banks of any one of these lakes in Massachusetts. The original settlers seem to have avoided them, and although in some cases towns have been extended to their shores, it would appear to have been an extension from necessity and not from choice. A few villages may be found about the outlets of the ponds, and these have generally had their origin in the water-power connected with the brooks which flow from them. As a general rule, however, the great ponds of the State are bounded by farms and by woodlands.

The capacity of these natural reservoirs for supplying our crowded population with pure water, is shown by lakes Cochituate and Wenham, and by Fresh and Mystic Ponds. These four lakes, which are no better than a hundred others within our borders, although more favorably situated for water-supply in the neighborhood of large cities, yield an average flow of about 25,000,000 gallons daily to the cities of Boston, Chelsea, Charlestown, Cambridge, Somerville and Salem, and to the town of Beverly.

In addition to this, there is an average daily waste, at the outlets of Wenham Lake and Mystic and Fresh Ponds combined, which must amount, according to the best estimates we have been able to collect, to about 30,000,000 gallons. The draft upon Lake Cochituate has for some years past, been as great as it could supply,—fifteen to eighteen million gallons daily. The capacity of these four lakes for furnishing water, may be therefore estimated at about 55,000,000 gallons.*

Appended to this Report will be found a statement, furnished by Mr. H. F. Walling, giving the area in acres of every "great pond" in Massachusetts, together with its name, the township in which it is situated and its outlet.

It seems to have been supposed until within a few years, that it was of the first importance, in order to save expense, that the surface of any lake should be higher than the point at which its water was to be distributed, in order to make the force of gravity available.

It is now seen, however, that by the aid of force-pumps and elevated reservoirs or stand-pipes, that a deficiency of natural elevation is very readily overcome.

This is done at Wenham and at Cambridge, and elsewhere, with facility, and at no enormous cost; certainly the expense of this machinery, and its care can bear no comparison with the interest on the outlay required to bring the water from very distant and elevated regions by gravity alone. The important point in this connection is to know that engineering skill can readily avail itself of any neighboring lake, whether it be above or below the town to be supplied with water.

There are also real advantages to be gained in the case of lakes at a low level. They have a better supply of water in dry seasons, and their constant yield is more sure. Wenham Lake illustrates this fact. It is but thirty feet above tide-water and comprises 255 acres, and the extreme difference of level of its surface, noted at all seasons, while supplying 1,300,000 gallons per day, and including the drought of the summer of 1871, has been but eleven inches.

* The daily supply of London is about 100,000,000 gallons.

Fresh Pond with an area of 175 acres, is also very near the level of the sea, is but little affected by drought, and supplies 1,700,000 gallons per day without any appreciable change of level. Lake Cochituate has an area of 690 acres and supplied from its own resources before the connection was made with Sudbury River, fifteen to eighteen million gallons daily. Its elevation is 125 feet above tide-water, and in seasons of drought, like the summer of 1871, its level was greatly reduced.

Great Ponds are Public Property.

By a wise provision of our forefathers the "Great Ponds" of Massachusetts are, with very exceptions, public, and not private property. This clearly appears by a decision of Judge Hoar, in October, 1862, in the case of "Inhabitants of West Roxbury *vs.* Enos M. Stoddard and another" (see Allen's Reports, vol. 7, page 158).

Great Ponds, containing more than ten acres, which were not before the year 1647 appropriated to private persons, were, by the colony ordinance, made public, to lie in common for public use. The boundary on a natural pond extends only to low-water mark; beyond this point they are public property, except in cases (which must be very rare) where private grants were made more than two centuries ago.

They are indeed possessions of great value; capable of being made to supply most of our cities and towns with the means of promoting temperance and health, of giving them in abundance one of the great essentials of comfort and convenience, and of encouraging every form of useful industry.

But their value in the future depends upon the care which is taken to protect them from pollution. Cities and towns are extending in every direction and threaten to encroach upon their shores. Unless the danger is appreciated and guarded against, some of our most valuable lakes will soon become receptacles for sewage, and the precious inheritance of the founders of Massachusetts will be squandered and lost.

As examples of this danger we would invite attention to Lake Cochituate and to Mystic Pond; the former supplying Boston and the latter supplying Charlestown, East Boston, Chelsea and Somerville.

Twenty-six years ago, when Lake Cochituate was first appropriated for its present use, its shores were occupied by farms. The village of Natick was a mile from its southern extremity. But Natick has now 7,000 inhabitants, and has extended northwards in the direction of the eastern side of the lake, and houses and manufacturing establishments are coming very near its border.

The natural drainage of the town is obviously into the lake. Natick must soon have sewers,—it already has private drains from factories and houses,—and unless attention is given in time to this state of affairs, the water-supply of Boston* must inevitably be affected in quality.

The following table of analyses will throw some light on this question, and also on the effect of adding the water of Sudbury River. Of the comparative influence of these two causes in producing the changes observed we can give no opinion, except to say that it seems probable that Sudbury River is chiefly responsible.

Cochituate Water in former days. (Parts in 100,000.)

ANALYZED BY—	Total Solid Matter.	Inorganic.	Organic and Volatile.
Professor Horsford, 1848, ...	5.35	2.90	2.45
Professor W. R. Nichols, Dec., 1870, .	4.20	3.08	1.12

Cochituate Water in Boston in 1872, since Sudbury River connection. (Parts in 100,000.)

Professor W. R. Nichols, Nov. 20, 1872, .	8.00	–	–
Dec. 12, 1872, .	5.28	3.00	2.28
Dec. 17, 1872, .	5.24	2.96	2.28
S. P. Sharples, Oct. 1, 1872, . . .	4.79	2.01	2.78

Mystic Pond now receives, directly and indirectly, a great part of the sewage of Woburn and Winchester, including the refuse of the great tanneries in those towns. This fact, full of danger for the future, was made the subject of special investigation by the authors of the present Report, in 1870;

* See remarks of our correspondent at Natick, under "Health of Towns."

and their conclusions were, as before stated, published in the Second Annual Report of this Board, 1871. The evil has not diminished since that time, although many of the manufacturers have made efforts to prevent contamination of the water.

The remedy is clearly to be found in establishing a complete system of sewerage, for both the towns above mentioned, having its outlet in Mystic River below Medford.

How can our Great Ponds be preserved from pollution, so that they may be used when needed as sources of water-supply by the cities and towns of the Commonwealth? To accomplish this it seems essential in the first place, to forbid the entrance of any sewer or drain into any "Great Pond," or into any water-course having its outlet in a "Great Pond." And in the second place to either secure the possession of a strip of land of moderate width around their borders, or in some other way to prevent the erection of dwellings or factories within such limits, leaving this strip of land to act, under natural agencies, as a filter for the purification of all the water which may percolate through it from the adjacent country. Such a reservation would, in the neighborhood of great cities, furnish a delightful park and driveway, thus contributing to the health and enjoyment of the people in many ways.

The effect of woodlands surrounding our lakes and ponds is undoubtedly beneficial to their waters. They protect the banks from being washed away, and prevent the soil from being carried into the lakes by torrents of rain. They also equalize the supply of water from the surrounding water-shed.

Spongy woodlands are reservoirs of moisture, and regulators of the flow of springs. As a country is denuded of wood it becomes parched and arid by reason of the rapid conveyance of rain to the neighboring water-courses, whose banks are torn by their violence. There are many instances, both in our own and other countries, of regions, once fertile, becoming barren wastes through such wanton destruction of trees. For such reasons we would advise the preservation of trees around our lakes, and planting them wherever they do not now exist.

It is not our province to indicate the legal methods by which such preservation of the lakes and great ponds can be secured either by the action of the legislature, or of the cities and towns within whose boundaries they may be comprised, but we earnestly desire that the people of Massachusetts, should protect them for the benefit of future generations.

We have thus reviewed the subjects included in the order of the legislature as completely as the time allowed would permit. They seem to us of vast importance, and worthy of continued examination in future years.

[The chemical portions of the preceding Report have been prepared by Prof. Nichols, who visited England during the summer of 1872, and saw the various attempts there making to purify and to utilize sewage. Most of the analyses were made in the laboratory of the Massachusetts Institute of Technology, under the personal direction of Prof. Nichols, by Miss Ellen H. Swallow, A.B. Those made in July and August, during the absence of Prof. Nichols, were conducted by Mr. Frank P. Pearson at the Bussey Institution in West Roxbury, the laboratory of which was kindly placed at our service by Prof. Storer.

Sanitary questions, the subject of water-supply, and the arrangement of this Report have been in the hands of the Secretary of the Board. Economical questions have been divided between the authors, who are also jointly responsible for all statements both of fact and opinion.]

In the Appendix will be found :—

1. A report from Mr. Phinehas Ball, on the possibility of utilizing the sewage of Worcester.
2. A report from Mr. H. F. Walling, concerning the "Great Ponds" of Massachusetts.

APPENDIX A.

THE OPPORTUNITY AND POSSIBILITY OF UTILIZING SEWAGE IN THE CITY OF WORCESTER.

To the State Board of Health.

This paper is not contributed in order to impart information in relation to what has been accomplished by Worcester in utilizing sewage, for nothing has yet been done in aid of a solution of the difficult problem. Its aim is to point out the possibilities and to state some of the means that are at command by which a desirable result may be attained.

The necessity of the utilization of sewage follows almost inevitably from the present popular mode of conveying away from our habitations and workshops, the contents of water-closets and urinals, with sink and other washings, by the modern water-carriage system.

The full benefit of a public supply of water cannot be realized in the absence of sewers, nor can all the comfort and luxury of the family be enjoyed without the service of both the modern water-supply and effectual sewerage. The water-carriage system of conveying sewage from our premises, falls naturally into harmony with our present notions of the application of all labor-saving machinery to the promotion of human comfort and improvement.

Its popularity is derived from the fact, that after the apparatus of water-closet, urinal, sink, bath-tub and waste-pipe in the dwelling or manufactory are once properly arranged and connected with the sewer, their operations go on silently and constantly, with but little care or attention on the part of the users.

These conveniences, thus arranged, are salutary and beneficial in the highest degree in all populous districts, but the refuse mingling with the water used for a thousand domestic and manufacturing purposes, imparts to it so many defiling and polluting properties, that its removal by the present system only takes the nuisance from one locality and transfers it, greatly diluted, to another.

The sewer-system in all inland cities and villages, is forced to connect its outfalls with the nearest available brook or river, into which to deliver the contents, with their innumerable defilements.

These sewer-poisons contaminate the water in the streams, transforming that which, in its purity, is a blessing, into a nuisance and a source of disease.

Thus while the crowded population is relieving itself, effectually and economically, of its refuse and waste materials, it is turning

them over, in the shape of defiled water, to the injury and abridgment of the rights of every riparian owner.

Two objects are to be sought in the utilization of sewage.

First.—To prevent the pollution of rivers and streams; and

Second.—To so conduct the process of purification, that the resulting product may enrich the soil, and be remunerative for the labor employed and the capital invested in the undertaking.

The city of Worcester is located in a valley, through which run the waters of Mill Brook. The most populous portion of the city covers an area of from $2\frac{1}{2}$ to 3 square miles. This area is occupied by from 30 to 35 thousand inhabitants, and also contains the larger share of all its varied manufacturing establishments. As an inevitable result of the location of the city, its sewage and drainage is conducted directly into Mill Brook, the contents of which are then discharged into and defile the Blackstone River.

Not much was done in the matter of building sewers in the city until 1867. In this year was commenced the walling and arching of Mill Brook, which work, at the present has been nearly completed for a distance of about two miles northerly from Cambridge Street.

In the same year was also commenced the building of a system of street sewers, to be used for drainage and sewerage, the outlet of all of which was made directly into the channel of Mill Brook. The construction of sewers has been continued year by year since its commencement. The total number of lineal feet now laid is 146,068, or nearly $27\frac{3}{4}$ miles; so complete is the system that it includes every street in the district provided for. The depth at which they are laid ranges from 7 to 19 feet, the average depth being probably about 10 feet.

At this depth they are sufficiently low to drain all cellars on adjacent streets, and even underdrain many of them. In this location, they answer all the purposes of subsoil drains, sewers for the contiguous estates, and drains for conveying away the surface-water falling on the streets and adjacent lots.

As before stated, these drains all empty into Mill Brook.

The territory above given, on which is congregated the most densely inhabited portion of the city, has its sewerage concentrated by outlet mains and Mill Brook, where the brook crosses Cambridge Street. This point is only a few rods above the junction of Mill Brook with the Blackstone River.

This point of the intersection of Cambridge Street with Mill Brook, is the point of departure in conveying the sewage delivered by the sewers into Mill Brook, from the waters of the Blackstone River. It lies at the head of the flowage of the pond, formed by the dam across the Blackstone River at Quinsigamond village, so

called, in said city, and about 4,000 feet northerly of the iron works in said village.

The area drained by Mill Brook lying north of Cambridge Street, and with which we have now to deal, as connected with the sewers, is between $10\frac{1}{2}$ and 11 square miles. The quantity of water furnished by this area averages about 11,000,000 gallons per day. This amount is not regularly delivered by the brook because, during freshets, large quantities are carried off in a short space of time, after which freshets the constant flow is much below the annual average.

During the summer of 1871, the flow of Mill Brook was gauged for seventy-nine days, and its average during this time was found to be 4,198,000 gallons per day. From April to December, this quantity may be taken as the average dry-weather flow; when the stream is swollen by freshets or rains, the quantity would probably average from two to ten times as much as this measurement.

Taking the dry-weather flow as 4,000,000 gallons, we have 533,333 cubic feet, a quantity sufficient to flow $12\frac{1}{4}$ acres of land one foot deep, or 147 acres one inch every twenty-four hours. To deal with this quantity, would equal 365 inches on 147 acres per annum, or $7\frac{6}{10}$ times the average annual rainfall in the city, as derived from the records kept at the State Lunatic Hospital. This quantity is far larger than could be dealt with by any process of precipitation or irrigation, at the commencement of any scheme of utilization.

After the accumulation of large experience, this quantity or even a larger might be successfully treated and purified.

In the fall of 1871, two measurements were made of the quantity of water discharged into Mill Brook from the sewers, in what may be termed the dry-weather days.

From this investigation it appeared, that for a larger part of the time, the amount to be dealt with might be placed at 1,500,000 gallons. From this estimate is excluded Pine Meadow and Bear Brooks, except at such time as the drainage by natural flow is reduced to a minimum.

This quantity may be taken as the sewage proper of the town at the present time, diluted with such subsoil drainage as is constantly finding its way into the sewers in the several districts. In two districts this subsoil drainage amounts to the largest part of the contents delivered by the sewers.

This subsoil drainage must always be included in the sewage, so long as the present system of sewers is maintained.

No accurate measurements have ever been made to determine the quantity of water drawn from the aqueduct in the city.

From such observations as have been made upon that question, the inference has been drawn, that the average quantity daily used, is at present between $2\frac{1}{2}$ and 3 millions gallons. As has been before stated, the quantity of sewage to be dealt with in any system of utilization cannot be less than 1,500,000 gallons. To separate this from the ordinary flow of Mill Brook, is the first and most obvious problem.

It is apparent that this division can only be effected on such days as those in which the normal flow is unaffected by storms or rains.

The extension of the Piedmont sewer from its present outlet to Cambridge Street, will deliver the sewage from a little less than a square mile of this territory, into Mill Brook, at the point where its interception from entering and conveyance away from the Blackstone River must commence. Southerly and south-westerly of Piedmont Street district lies a district included in the territory under consideration, not yet provided with sewers; whenever this district is sewered, the outlet may be connected with the Southbridge-Street line, or may teminate separately at Cambridge Street. For these two districts, the separation of the ordinary dry-weather flow from Mill Brook is a problem of easy solution.

To collect the ordinary sewage from the twenty-nine sewers now entering Mill Brook, north of Cambridge Street, and make provision for future sewers, is a requirement less easy to fulfil.

To make this division the following plan is proposed:

The paving of the walling and arching of Mill Brook is laid on a curve or segment of a circle, the versed sine of which falls about two feet below the springing line of the arch on the skewbacks. The entrances of the sewers are made over the skewbacks, and above the springing line of the arch. This form of construction permits the laying of a cast-iron pipe in the centre of the canal, in such a position that branches may be laid from this central main to each sewer in succession, of sufficient size to take the normal sewage into this main separating-pipe. It would be necessary to extend this pipe from Cambridge Street to Lincoln Square, in the first instance, leaving it for future extensions northerly, as sewers should be laid for those districts.

The size of the pipe laid in the centre of the canal would be from twenty to thirty inches in diameter, and as it has to bear no large internal pressure, if of iron, may be cast as thin as practicable. Its fixtures would only be a suitable number of manholes, placed at convenient distances, with covers fitted in place, so as to be easily removed, for its inspection internally and the removal of such accumulation of sediment, as might be deposited therein; the side connections with the several sewers, to be made by lateral pipes of

suitable size to convey to the main the normal sewage contents of each sewer; each of these laterals to be fitted with a self-closing gate at its open end, so arranged as to be closed instantly when any amount of water should come from the sewer, as in a storm or rain, above the normal amount gauged by the setting of the gate.

The foregoing is a brief description of the arrangement proposed, for dividing the dry-weather sewage from the ordinary flow of the stream. It cannot be made clearly intelligible in all its details, without the aid of plans, but, undoubtedly, sufficient has been said to convey a general idea of its practicability.

Having collected the sewage as above described, at a point at Cambridge Street, it is now in position to be conveyed away separately. This can be done by building a conduit of suitable size running southerly about 4,000 feet, to the head of the old Blackstone Canal south of Millbury Street in the village of Quinsigamond. From Cambridge Street to the old canal, the fall is sufficient to allow the sewage to be discharged above the surface of its waters. This canal is 1,800 feet in length and about thirty feet wide, and four feet deep as originally built. It may be cleared out and fitted for a settling basin, for the grosser matters brought by the sewers, which may be removed from time to time, or it might be arranged to be used for any precipitating process which promises a remunerative return for the expense of working it. From this canal, water may be drawn to a limited extent and used for the purpose of irrigation. From this canal may be commenced conducting-pipes, laid on the declivity of the sloping hill-sides as we go southerly, for the purpose of conveying the sewage to land on which it may be used for irrigation or purification by filtration. The valley of the river as it leaves the end of the old canal lies very nearly south.

It has been examined as far down as the Greenwood Mills in Millbury, a distance of about two miles below where the sewage would leave the canal.

On the east side of the valley a conducting-pipe could be commenced at once and be continued on the side-hill to the Mills, and doubtless far beyond, without any obstruction in the form of ravines or valleys, and be in such a position as to advantageously deliver its contents upon land at all points as it progresses.

To reach the westerly slope of the valley a viaduct about 700 feet long would be required to convey it over the Blackstone River; when this point is reached the irrigating conduit may be carried as far upon the west as upon the east side of the valley, and have the same useful location as would that upon the east side.

From the old canal to Greenwood's Mills there are about 800

acres of land that would be covered by the extension of the two main conduits above specified.

This area is not the limit which may be reached by an extension of the main lines in the valley below the Greenwood Mills; and by elevating the sewage by steam or by *wind-mills*, the area on to which this sewage may be carried could easily be enlarged to 2,000 acres.

The soil is varied in its character; that along the river-banks being the ordinary sandy intervale land so common in New England. Of this the amount is quite limited.

On the west of the river there is much light sandy and gravelly soil, now nearly worthless for agricultural purposes.

Some of these flats lie some twelve to twenty feet above the intervales, and would form a fine opportunity to test what is called the intermittent system of "Cubic Filtration" for the purification of the sewage, so much advocated by some English engineers. On the west there is one swamp of about one hundred acres that would afford a good opportunity to try winter flushing to a large extent, in order to test its value on a summer crop of grass on the same ground. On the east, much of the soil of the valley is a cold, clayey, hard-pan, forming good lands for grass, while the western side is much the best for the cultivation of all the varied vegetables, cereals, and small fruits which might be attempted with profit.

The land is now in every varied condition, from the tangled bramble-bush pasture or wooded area, to the cultivated mowing and tillage field. To be used for any purpose like that indicated, it would need special preparation by clearing, under-draining, and constructing proper conduits to convey and flush the sewage over the ground, with proper drains to carry to the river the superfluous water.

To bring this whole area into proper condition to be used efficiently for this purpose would be a large undertaking, and one to be worked out step by step during several years, profiting each year in extending the work by the experience gained in its predecessors.

In this way, any large mistake might be avoided that would be risked were it attempted to put the whole land in a proper condition before anything was done in the way of irrigation for useful purposes.

It is not now intended to go into the minute details as to the mode of procedure that should be followed to carry out a work of this kind, or to indicate what is deemed best as to the manner of constructing the various kinds of appliances needed to insure economy of transport and delivery of the sewage, and success in its application to the land.

The only aim has been to point out the possibility, by indicating briefly the ground that might be used for the purposes of irrigation or filtration, and to state in brief the manner of collecting and diverting these polluting matters from the Blackstone River.

No attempt has been made to specify the details of any system, or even arrange any such system, beyond a mere outline of its main features. These details are left for a more careful study, and as a proper matter, to be arranged and adopted after the attainment of some experience.

The value of irrigation has long been known to the practical agriculturist.

Its history is almost coeval with that of the race.

There can be no question as to the value of sewage, when used properly, as an agent in the promotion of the growth of every crop useful to man. Sewage has been thus successfully applied in England and on the Continent. In this country there is little or no practical experience to guide us in an undertaking of this kind.

To adopt European methods without modification would be of doubtful utility, our climate, soil and various other conditions are so different from theirs. Success in enterprises of this kind in this country must be based upon home experience, but when this is once attained, every inland village, city and manufactory will regard it as a useful addition to their system of water-supply and sewerage.

The elements of success in the utilization of sewage, are the same as those that go to make up success in any calling in life.

For each enterprise there must be one responsible manager, and he must study the means used in all their detail, and the results attained in all their variety, as carefully as the successful merchant studies the wants, wishes and tastes of his customers, and note processes as assiduously as the merchant consults from day to day the prices-current of goods in the market. He must be as wide-awake to note every fact, and determine its relation in the chain of cause and effect in the results taking place under his observation, as is the banker to ascertain the fluctuating market-price of stocks and of gold, and the rise and fall in the rate of interest. When thus pursued enthusiastically, success is as sure in this undertaking as in any manufacturing or mercantile enterprise whatever.

When the plan has been devised, and its details arranged and its operations set in motion, all oversight must not end here, any more than care for power in the manufactory ends with the placing of the steam-boilers and the engine. In fact, care begins with their use, and good results are only attained by the most intelligent watching and caring for all the processes concerned in the result.

So in the utilization of sewage, the manager's system of delivery-pipes is his engine, his gates the regulators of his work, the sewage the fuel that feeds the growing crop, and it is his sole business to furnish that fuel in just that quantity, and at the proper time, to produce the largest fruitage from that crop.

By this mode of procedure it will soon create a science of its own.

When this science shall have been thus carefully collated from actual experience, it will then safely pilot all who would commence works of this kind to a sure and successful accomplishment of their enterprises.

PHINEHAS BALL.

WORCESTER, December 31, 1872.

Appendix B.

102 Chauncy Street, Boston,
October 10, 1872.

George Derby, M. D., *Secretary of the State Board of Health.*

I present to you herewith, in accordance with your request, a list of the ponds or lakes in the State whose areas exceed ten acres. It is arranged in tabular form by counties and towns, and gives, from the best attainable authorities, the names of the ponds and lakes, their location, areas and outlets.

The areas have been computed generally upon the county maps, by means of an Amstler's Planimeter, and have been verified by independent repetitions. It should be stated here, however, that no systematic instrumental survey of the waters of the State has been made. So far as my knowledge extends the representations of ponds, lakes, rivers and streams upon existing maps have generally been made by estimating distances from the travelled roads by the eye, aided by some rude triangulation, with an ordinary surveyor's compass. This of course gives only a rough approximation to accuracy, which, accordingly, is all that can be claimed for the table herewith presented.

It is greatly to be desired that an accurate plane-table survey of the entire State, giving contour lines, etc., should be made in connection with the careful triangulation which was carried through the State some years ago by Mr. Borden.

In sanitary investigations such a survey would be eminently useful, the elevation of the ground, distribution of water, etc., entering as important elements into these investigations, while for all engineering operations, such as the water-supply of towns and the construction of railroads and other public works, its value would far exceed its cost, as has been shown by experience in those States of Europe where surveys of this kind have been made.

Very respectfully yours,

H. F. WALLING.

BERKSHIRE COUNTY (Total No. of acres, 6,226).

Name.	Area in acres.	Outlet.
Florida.		
North Pond,	12	Cold River.
Hancock.		
Mountain Pond,	20	– –
Lanesborough.		
Pontoosuc Lake,	313	Housatonic Riv.
Pittsfield.		
Lake Onota,	555	
Lily Pond,	20	
Silver Lake,	20	Housatonic Riv.
Sylvan Lake,	10	
Savoy.		
South Pond,	28	Cold River.
Windsor.		
Windsor Pond,	107	Westfield River.
Hinsdale.		
Reservoir,	54	Housatonic Riv.
Peru.		
Mill Pond, near the centre,	20	Fuller Brook.
Richmond.		
Richmond Pond,	178	Scott Brook.
Washington.		
West Pond,	75	Roaring Brook.
Clapp Pond,	10	
Ashley Lake,	38	Ashley Brook,
Muddy Pond,	50	– –
Benson Pond,	27	W. Br. of Westfield River.
Basin Pond,	67	Housatonic Riv.
West Stockbridge.		
Cranberry Pond,	15	
Crane Pond,	33	
Shaker Mill Pond,	70	
Pond near Richmond Line,	22	Williams River.
Mill Pond, Williamsville,	13	
Stockbridge.		
Lake Mahkenac,	250	
Mountain Mirror,	45	Housatonic Riv.
Mohawk Lake,	23	
Agawam Lake,	25	
Lee.		
Laurel Lake,	152	
Goose Pond,	225	Housatonic Riv.
Long Pond,	62	
Becket.		
Greenwater Pond,	100	Housatonic Riv.
Yokum Pond,	118	
Wheeler Reservoir,	100	W. Br. Westfield River.
Rudd Pond,	96	
Centre Lake,	163	
Horn Pond,	21	Walker Brook.
Ward Pond,	22	Farmington Riv.
Shaw Pond,	100	
Egremont.		
Winchel Pond,	140	Green River,
Marsh Pond,	72	Willard's Br'k.
Great Barrington.		
Pond near centre,	26	Housatonic Riv.
Long Lake,	96	Seekonk River.
Monterey.		
Six-Mile Pond,	344	Mill River.
Brewer Pond,	250	
Otis.		
Thomas Pond,	90	
Pond below Thomas Pond,	39	Farmington Riv.
Hayes Pond,	63	Hop Brook.
Pond in Otis Centre,	24	
White-Lily Pond,	50	
Mill Pond west of White-Lily Pond,	25	
Haley Pond,	18	
Great Lake,	335	
Parish Pond,	42	Farmington Riv.
Rand Pond,	235	
Pond above Rand Pond,	20	
Pond below Rand Pond,	95	
Larkum Pond,	38	
Mount Washington.		
Gilder Pond,	53	Gilder Brook.
Lee Pond,	11	Lee Pond Br'k.
Plantain Pond,	120	– –
Sheffield.		
Harmon Pond,	20	
Spur Lake,	20	
Davis Pond,	35	
Pond north of Davis Pond,	14	Williams Br'k.
Pond near Sheffield Plain,	93	
Three-Mile Lake,	104	Housatonic Riv.
New Marlborough.		
Juniper Pond,	20	Mill River.
Harmon Pond,	33	Umpachina Riv.
East Pond,	104	– –
Sandisfield,		
Pond near West Otis,	18	
Upper Spectacle Pond,	78	Clam River.
Lower Spectacle Pond,	113	
Reservoir,	53	
Simons Pond,	76	Farmington Riv.

FRANKLIN COUNTY (Total No. of acres, 2,184).

Name.	Area in acres.	Outlet.
Rowe.		
Reservoir Pond,	75	Pelham Brook.
Coleraine.		
Pond in Foundry Village,	15	North River.
Leyden.		
Greenfield Aqueduct Pond,	13	Buddington [Creek.
Northfield.		
Pond on Erving Line,	16	Keyup Brook.

HAMPSHIRE COUNTY—Concluded.

Name.	Area in acres.	Outlet.
Three contiguous ponds west of River,	16 15 13	Bennett's Br'k.
Pond near Cragg Mountain,	15	Keyup Brook.
Gill.		
Pond near centre,	17	Unadilla Brook.
Otter Pond,	14	Otter Pond Brk.
Orange.		
North Pond,	78	Middle Branch [Swift River.
Pond east of North Orange,	66	Tully River.
Pond E. of same,	40	
Warwick.		
Pond near New Hampshire line,	15	Valley Brook.
Bass Reservoir,	50	Mill Brook.
Pond southwest of the same,	57	
Pond northeast of the Centre,	11	Orcutt's Brook.
Pond north of the same,	15	
Hastings' Pond,	27	
Pond east of Hastings' Pond,	26	
Upper Pond on Tully Brook,	30	Tully River.
Lower Pond on Tully Brook,	10	
Moore Pond,	25	Moss Brook.
Delva's Pond,	20	
Pond west of the same,	60	
Long Pond,	84	
Pond east of Long Pond,	118	
Pond near southeast corner,	56	Orcutt's Brook.

Name.	Area in acres.	Outlet.
Ashfield.		
Great Pond,	60	South River.
Williams Pond,	26	Swift River.
Pond south part,	13	
Conway.		
City Pond,	25	Swift River.
Montague.		
Green Pond,	13	None.
Wendell.		
Mill Pond in west part,	15	Miller's River.
Wicket Pond,	83	
Pond in northeast part,	15	
New Salem.		
Reservoir in northeast corner,	320	Miller's River.
Spectacle Pond,	90	
Hacker's Pond,	15	
Thompson's Pond,	235	Middle Branch Swift River.
Pond above the same,	30	
Nanee Lake,	13	None.
Millington Mill Pond,	12	Middle Branch Swift River.
Hop Brook Pond,	20	
Sunderland.		
Cranberry Pond,	22	Cranberry Br'k.
Leverett.		
Fish Pond,	33	Roaring Brook.
Shutesbury.		
Lock's Pond,	127	Saw-Mill River.
Pond near Dudleyville,	20	

HAMPSHIRE COUNTY (Total No. of acres, 2,282).

Plainfield.		
Plainfield Pond,	45	Chickley's Riv.
Crooked Pond,	21	Westfield River.
Pond on Hawley line,	25	Chickley's Riv.
Goshen.		
Lily Pond,	57	Swift River.
Reservoir,	100	W. Br. Mill Riv.
Dresser Pond,	44	E. Br. Westfield River.
Middlefield.		
Pond near centre,	12	W.Br.Westfield [River.
Chesterfield.		
Burnell's Pond,	37	Dead Br. Westfield Riv.
Hatfield.		
Pond in west part,	20	Mill River.
Two ponds in north-east part,	17 23	Connecticut Riv.
Hadley.		
Pond, southeast of the village,	40	Fort River.
Pond, east of North Hadley,	48	Mill River.
Pond, north of Plainville,	49	

Amherst.		
Pond in North Amherst,	15	Mill River.
Pond at Mill Valley,	23	Fort River.
Pond in east part,	11	None.
Prescott.		
Gibbs Pond,	22	Middle Branch Swift River.
Hackmetack Pond,	15	
Mill Pond, northwest of same,	13	
Large Pond and Swift River,	154	Swift River.
Pond above the same,	17	
Huntington.		
Norwich Pond,	128	E. Br. Westfield [River.
Westhampton.		
Pond in south part,	11	N. Br. Manhan [River.
Hanging Mountain Pond,	10	Roberts Brook.
Southampton.		
Hampton Pond,	197	Pond Brook.
Northampton.		
Pond, near Ox Bow,	80	Connecticut Riv.

HAMPSHIRE COUNTY—Concluded.

NAME.	Area in acres.	Outlet.
Easthampton.		
Upper Mill-Pond,	53	Manhan River.
Lower Mill-Pond,	35	
South Hadley.		
Pond in north part,	16	Elmers Brook.
Upper Pond, in S. Hadley Village,	12	Stony Brook.
Lower Pond in South Hadley Village.	16	
Taylor Pond,	15	None.
Granby.		
Pond, north of Centre,	30	Batchelder Br'k.
Pond, near Belchertown line,	115	
Belchertown.		
Pond in north part,	17	Jabish River.
Middle Pond,	40	Batchelder's Brook.
Lower Pond,	90	

NAME.	Area in acres.	Outlet.
Mill Pond, near Granby line,	10	Batchelder's Br.
Mill Pond, southeast from R. R. station,	22	Jabish River.
Enfield.		
Train Pond,	13	Beaver Brook.
Morton Pond,	20	
Greenwich.		
Bullhead Pond,	23	None.
Curtis Pond,	155	Middle Branch Swift River.
Luce Pond,	124	
Pond in Greenwich Village,	30	East Br'ch Swift River.
West Pond,	94	
Flask Pond,	18	Middle Branch Swift River.
Davis Pond,	100	East Br'ch Swift River.

HAMPDEN COUNTY (Total No. of acres, 4,148).

NAME.	Area in acres.	Outlet.
Blandford.		
North Meadow Pond	80	Westfield Little River.
Long Pond,	150	Muddy Pond Brook.
Blair Pond,	215	Westfield Little River.
Russell.		
Hazzard's Pond,	60	Westfield River.
Montgomery.		
Shatterack Pond,	17	Shatterack Br'k.
Westfield.		
Buck Pond,	30	Sackett's Br'k.
Horse Pond,	45	
Holyoke.		
Hitchcock Pond,	58	Block Brook.
Ashley's Pond,	96	
Chicopee.		
Slipe Pond,	114	None.
Slabbery Pond,	69	
Smooth Pond,	10	
Springfield.		
Pond at Indian Orchard,	15	None.
Five-Mile Pond,	96	
Pond, west of the same,	26	
Loon Pond,	18	North Br'ch Mill [Riv.
Lake Como,	10	None.
Water-Shop Pond,	328	Mill River.
Bass Pond,	24	None.
Ludlow.		
Pond in north part,	13	Stony Brook.
Pond in west part,	11	None.
Pickerel Pond,	11	
Chapin's Pond,	45	
Woods' Pond,	31	Chicopee River.
Pond east of Woods' Pond,	18	None.
Mill Pond below Jenksville,	75	Chicopee River.

NAME.	Area in acres.	Outlet.
Palmer.		
North Pattaquattic Pond,	15	Ware River.
South Pattaquattic Pond,	50	
Pond west of Thorndike,	13	None.
Calkins Pond,	32	Ware River.
Tolland.		
Messenger or Cotton Pond,	580	Farmington Riv.
Noyes Pond,	276	Hubbard's Riv.
Hall's Pond,	33	
Cranberry Pond,	17	Slocum Brook.
Granville.		
Brack Pond,	28	– –
Pond east of the same,	12	Hubbard's Riv.
Southwick.		
Congamuck Pond,	589	Great Brook.
Agawam.		
Mill Pond, southwest part,	11	Still Brook.
Mill Pond, southeast part,	11	Connecticut Riv.
Wilbraham.		
Spectacle Ponds,	20	None.
Nine-Mile Pond,	36	
Pond in centre of Wilbraham,	30	South Br'ch Mill River.
Monson.		
Pond in centre,	11	Quabaug River.
Brimfield.		
Baker's Pond,	16	Quinebaug Riv.
Grape Pond,	95	Town Brook.
Little Alum Pond,	134	Quinebaug Riv.
Pond, southwest of centre,	13	Mill Brook.
Wales.		
Wales Pond,	66	Mill River.
Holland.		
Holland Pond,	64	Quinebaug Riv.
Hamilton Reservoir,	331	

WORCESTER COUNTY (Total No. of acres, 25,007).

NAME.	Area in acres.	Outlet.
Royalston.		
Long Pond, . .	80	Tully River.
Pond, east of the centre, . . .	25	Lawrence Br'k.
Pond, south the same,	23	
Winchendon.		
Pond at Bullardsville,	20	
Part of Monomonac Pond, . . .	114	
Upper Mill Pond, North Village, .	81	Miller's River.
Pond on Ashburnh'm line, . . .	100	
Pond, southwest of the same, . .	44	
Pond at New Boston,	87	
Pond, southeast of the same, . .	54	Otter River.
Reservoir, south p'rt,	122	
Ashburnham.		
Lower Naukeag Pond, . . .	150	Miller's River.
Upper Naukeag Pond, . . .	302	
Pond in northwest part, . . .	16	Bear Meadow Br'k.
Reservoir near Mt. Hunger, . .	75	Phillips Br'k.
Pond northwest of the same, . .	16	
Stodge Meadow Br'k,	58	- -
Ward Pond, . .	54	- -
Watatic Pond, . .	52	- -
Reservoir on Gardn'r line, . . .	300	Whitman's Riv.
Pond, north of the same, . . .	23	Miller's River.
Pond at Ashburnh'm Junction, . .	16	Whitman's Riv.
Pond at South Ashburnham, . .	28	
Athol.		
Babcock Pond, .	44	
Pond, south of Athol Centre, . . .	25	Miller's River.
White Pond, . .	100	
Pond south of the same, . . .	65	
Phillipston.		
Reservoir on line of Athol, . . .	130	Miller's River.
Pond, east of the same, . . .	30	Beaver Brook.
Phillipston Pond, .	202	Burn-Shirt Riv.
Pond, northeast of the same, . .	130	
Templeton.		
Pond at Baldwinsville, . . .	14	Otter River.
Upper Pond, east of Brook's Village, .	26	
Middle Pond, east of Brooks Village, .	25	Trout-Brook.
Lower Pond, east of Brooks Village, .	25	
Pond at East Templeton, . . .	96	Otter River.
Pond at Partridgeville, . . .	56	
Brown's Pond, . .	23	Burn-Shirt Riv.

NAME.	Area in acres.	Outlet.
Gardner.		
Pond, west of Gard'r Centre, . . .	38	
Pond, north of the above, . . .	25	
Crystal Lake, . .	216	Otter River.
Kendall Pond, . .	44	
Pond north of Cryst'l Lake, . . .	17	
Snake Pond, . .	18	None.
South Gardner Reservoir, . .	77	
Mill Pond, South Gardner, . .	30	Otter River.
Pond, west of the above, . . .	22	
Westminster.		
Muddy Pond, . .	78	Whitman's Riv.
Pond near South Gardn'r Reservoir,	31	Otter River.
Coolidge & Adams' Reservoir, . .	70	
Merriam's Reservoir,	31	
Meeting-house Pond,	172	Whitman's Riv.
Wachusett Pond, .	250	
Grassy Pond, . .	26	
Fitchburg.		
Pond, southwest cor.,	22	Whitman's Riv.
Pond at Rockville, .	24	Phillips Brook.
Lunenburg.		
Unkechewhalon P'd,	177	
Massapog Pond, .	80	Catacoonamug River.
Catacoonamug P'nd,	370	
Leominster.		
Reservoir, . .	508	
Rocky Pond, . .	45	Monoosnoc B'k.
Mill Pond at centre,	19	
Pond in southwest corner, . . .	45	Justice Brook.
Petersham.		
Reservoir on Athol line, . . .	136	Miller's River.
Reservoir, south of above, . . .	175	East Br. Fever [Brook.
Dana.		
Neesceponsett Pond, .	118	
Pond, south of the above, . . .	40	Fever Brook.
Sunk Pond, . .	15	East Br. Swift River.
Pottapaug Pond, .	160	
Hubbardston.		
Pond, west corner of Hubbardston, .	38	Burn-Shirt Riv.
Natty Pond, . .	40	Natty P'nd Br'k.
Pond, south of Natty Pond, . . .	17	
Pond in north corner of Hubbardston, .	40	Otter River.
Pond, southeast of the above, . .	47	
Reservoir, near Westminster line,	90	
Pond in east corner,	37	Ware River.
Mooschorn Pond, .	160	
Asnyconic Pond, .	238	
Princeton.		
Pond in north part, .	66	Keyes Brook.

WORCESTER COUNTY—Continued.

NAME.	Area in acres.	Outlet.
Pond in east part,	17	Still River.
Quinepoxet Pond,	75	Quinepoxet Riv.
Sterling.		
Pond in northwest corner,	23	Justice Brook.
Pond, northeast of centre,	10	Bailey Brook.
Waushaccum Pond,	180	South Branch Nashua River.
East Waushaccum Pond,	190	
Fitch Pond,	11	
Lancaster.		
White's Pond,	62	North Branch Nashua River.
Turner's Pond,	29	None.
Fort Pond,	118	
Little Spectacle P'd,	23	
Spectacle Pond,	94	North Branch Nashua River.
Oak Hill Pond,	33	
Cranberry Pond,	22	
Harvard.		
Hill Pond,	33	None,
Robbins Pond,	11	Nashua River.
Black Pond,	10	Beaver Brook.
Bare Hill,	320	Nonecanicus Brook.
Bolton.		
South Pond,	39	Assabet River.
West Pond,	42	Assabet Brook.
Berlin.		
Gates Pond,	16	Assabet River.
Pond at South Berlin,	19	
Hardwick.		
Mill Pond, in east cor.	18	Pine Hill Brook.
Pond, northwest of the above,	20	Moose Brook.
Muddy Pond,	202	Muddy Brook.
Pond, north of the above,	26	
Pond, south of Hardwick Centre,	15	Ware River.
Barre.		
Reservoir,	200	Ware River.
Pond, southeast of centre,	20	
Two Mill Ponds, in east part,	20 20	Burn-Shirt Riv.
New Braintree.		
Two contiguous p'ds near the centre,	94 75	Sucker Brook.
Oakham.		
Muddy Pond,	75	Muddy P'nd B'k.
Pond, southeast of centre,	25	Five-Mile River.
Browning Pond,	140	Seven-Mile Riv.
Rutland.		
Pond in north part,	22	Ware River.
Pond in west of the centre,	135	Long Pond Br'k.
Musquapog Pond,	110	Quinepoxet Riv.
Long Pond,	160	Long Pond Br'k.
Demon Pond,	138	
Turkey Hill Pond,	83	Turkey Hill B'k.
Paxton.		
Pond in west part,	40	Turkey Hill B'k.

NAME.	Area in acres.	Outlet.
Asnybumskitt P'd,	50	Asnybumskitt Brook.
Bottomly Pond,	124	Kettle Brook.
Upper Reservoir,	25	
Holden.		
Pond, west of Pine Hill,	77	Asnybumskitt Brook.
Pond at Eagleville,	90	
Pond, southwest of the above.	74	
Pond, northwest of Eagleville,	18	Quinepoxet Riv.
Pond at Quinepoxet Village,	28	
Rutland Pond,	24	
Pond at Unionville,	20	
Pond at Chaffenville,	92	
Pond at southwest corner,	100	Tatrick Brook.
Boylston.		
Mill Pond, north p'rt,	50	Nashua River.
Pond, west of Boylston Centre,	34	
Pond, south of Boylston Centre,	72	Muddy Brook.
Rocky Pond,	86	Cold Harbor Brook.
Sewal Pond,	36	Quinsigamond River.
Pout Pond,	16	None.
West Boylston.		
Pond in north part,	14	Shaker Brook.
Clinton.		
Ponds, west of centre,	133	Nashua River.
Sandy Pond,	75	
Clam-Shell Pond,	35	None.
Pond, west of above,	51	Nashua River.
West Brookfield.		
Wickaboag Pond,	323	Quabaug River.
North Brookfield.		
Brooks Pond,	178	Five-Mile River.
Horse Pond,	42	
Pond in northwest part,	11	Sucker Brook.
Furnace Pond,	305	Five-Mile River.
Brookfield.		
Mud Pond,	10	Moore's Brook.
Mill Pond, southeast of Furnace Pond,	13	Seven-Mile Riv.
Podunk Pond,	508	Quabaug River.
Pond, east of the above,	42	
South Pond,	340	
Pond, northwest of the above,	16	Mason Brook.
Pond, west of Podunk Pond,	30	
Pond, near West Brookfield line,	32	Quabaug River.
Spencer.		
Pond in northeast corner,	24	TurkeyMill B'k.
Pond in Wire Vil'ge,	18	
Pond, south of Hillsville,	25	Seven-Mile Riv.
Moose Pond,	52	
Pond, southwest from centre,	12	

WORCESTER COUNTY—Continued.

Name.	Area in acres.	Outlet.
Cranberry Meadow Pond, . . .	107	Cranberry Riv.
Stiles Reservoir, .	390	French River.
Leicester.		
Shaw Pond, . . .	126	Turkey Hill B'k.
Grosvenor Reserv'r,	50	Town Meadow Brook.
Pond, southeast of the above, . .	68	
Pond on Paxton line,	10	Kettle Brook.
Mann and Marshall Reservoir, . .	30	
Pond, southeast of the above, . .	10	
Worcester City Reservoir, . .	115	
Pond, southwest of the above, . .	43	
Lower Pond, Cherry Valley, . .	16	
Middle Pond, Cherry Valley, . . .	22	
Henshaw's Pond, .	69	French River.
Burn-Coat Pond, .	157	Burn-Coat Br'k.
Cedar Meadow P'nd,	233	
Greenville Reserv'r,	55	French River.
Pond, southwest of centre, . . .	13	Town Meadow [Br'k.
Rochdale Pond, .	82	French River.
Worcester.		
Pond in northwest part, . . .	32	Tatnick Brook.
Pond, southeast of Tatnick Village, .	35	
Pond, south of the above, . . .	14	
North Pond, . .	170	Mill Brook.
Pond, south of North Pond, . . .	17	
Coe's Reservoir, .	122	Tatnick Brook.
Pond in southwest corner, . . .	47	Kettle Brook.
Pond, south of New Worcester, . .	78	Blackstone Riv.
Pond, south of South Worcester, . .	16	
Pond in Quinsigam'd Village, . . .	24	
Shrewsbury.		
Newton Pond, . .	33	Quinsigamond River.
Quinsigamond Pond,	1,051	
Pond, southeast of Newton Pond, .	66	
Jordan Pond, . .	27	
Pond, northeast of the above, . .	15	
Northborough.		
Solomon Pond, .	20	None.
Bartlett Pond, . .	58	Stirrup Brook.
Little Chauncey P'd,	42	
Pond in southwest part, . . .	23	Assabet River.
Westborough.		
Chauncey Pond, .	185	Stirrup Brook.
Hobomoco Pond, .	31	Assabet River.
Cedar Swamp Pond,	15	Sudbury River.
Southborough.		
Brigham Pond, .	18	Stony Brook.
Pond, north of Fayville, . . .	31	
Pond, southwest of Southville, . .	18	Sudbury River.
Sturbridge.		
Alum Pond, . .	282	Quinebaug Riv.
Long Pond, . .	65	
Cedar Pond, . .	182	
Pond, north of the above, . . .	32	
Walker Pond, . .	152	Hobbs Brook.
Lead-Mine Pond, .	163	Lead-Mine B'k.
Pond, southeast of the above, . .	22	Hamant Brook.
Southbridge.		
Pond at Globe Vil'ge,	38	Quinebaug Riv.
Pond, southeast cor.,	17	– –
Charlton.		
Hicks Pond, . .	120	Cady Brook.
Pond, west of Charlton City, . .	25	
Pond, north of the above, . . .	15	
Lower Pond, Milward, . . .	34	Little River.
Upper Pond, Milward, . . .	16	
Pond in west part, .	20	Globe Brook.
Warren Pond, . .	58	Quinebaug Riv.
South Charlton Reservoir, . .	187	Little River.
Pond, east of the above, . . .	12	
Slater's Reservoir, .	90	
Oxford.		
Pond at Larned Village, . . .	30	French River.
Pond at North Oxford Station, . .	48	
Pond, southwest of the above, . .	16	None.
Upper Pond, Hodge's Village, . . .	23	French River.
Lower Pond, Hodge's Village, . . .	14	
Pond, southeast of centre, . . .	39	
Bugg Pond, . .	11	
Pond, near central turnpike, . .	37	
Pond, northeast of above, . . .	58	
Auburn.		
Stoneville Reservoir,	48	Kettle Brook,
Pond, northeast of the above, . .	30	
Pond, northeast of Stoneville, . .	175	Blackstone Riv.
Pond, north of centre,	28	
Pond, east of centre,	30	
Eddy Pond, . .	40	Dark Brook.
Millbury.		
Dorothea Pond, .	125	Blackstone Riv.
Pond, northwest of Millbury Village, .	28	
Lower Mill Pond, Bramanville, . .	12	Singletary Br'k.
Ramshorn Pond, .	145	Ramshorn Br'k.
Sutton.		
Singletary Pond, .	440	Singletary Br'k.
Two ponds, southwest of above, .	28 18	

WORCESTER COUNTY—Concluded.

NAME.	Area in acres.	Outlet.
Sibley Reservoir,	61	Cold Spring B'k.
Pond in Wilkinsonville,	32	
Pond, north of the above,	31	Blackstone Riv.
Pleasantdale Pond,	77	
Clark's Reservoir,	53	Cold Spring B'k.
Pond at West Sutton,	18	
Manchaug Pond,	333	
Pond, north of the above,	22	Mumford River.
Pond, southwest of Manchaug Village,	136	
Pond, north of Manchaug Village,	30	
Grafton.		
Goddard Pond,	105	Quinsigamond River.
Pond, northeast part,	20	Misquo Brook.
Pond, southeast part,	40	
Northbridge.		
Pond at Rockdale,	63	
Pond, southeast of the above,	24	Blackstone Riv.
Whitinsville Pond,	323	
Swan Pond,	41	Mumford River.
Pond at Linwood,	30	
Upton.		
Pond at West Upton,	40	West River.
Zachary Pond,	24	
Pratt's Pond,	25	Centre Brook.
Milford.		
Ponds, on line of Upton,	67	Mill River.
Cedar Swamp Pond,	174	
Pond on line of Bellingham,	65	Charles River.
Mendon.		
Taft's Pond,	160	Blackstone Riv.
Dudley.		
Gore Pond,	224	
Pierpont Meadow Pond,	92	Little River.

NAME.	Area in acres.	Outlet.
Hayden Pond,	50	
Pond, south of the above,	26	
Larned Pond,	65	
Pond, northwest of the above,	28	French River.
Peter Pond,	65	
Pond in Merino Village,	138	
Pond, southeast cor.,	16	
Webster.		
Nipmuck Pond,	24	Sucker Brook.
Kingsbury Pond,	40	
Chaubunagungamaug Pond,	1,230	French River.
Douglas.		
Reservoir,	470	
Wallis Pond,	47	
Upper Pond, in East Douglas,	17	Mumford River.
Bad Luck Pond,	106	
Baiting Pond,	15	– –
Wallum Pond,	150	– –
Uxbridge.		
Reservoir, northwest part,	186	
Pond at Uxbridge Village,	18	Mumford River.
Pond at North Uxbridge,	24	
Pond, northeast of above,	30	
Pond, northeast of Uxbridge Village,	20	Blackstone Riv.
Pond at Ironstone,	53	
Chocalog Pond,	22	– –
Black Pond,	13	None.
Pout Pond,	13	West River.
Blackstone.		
Harris Pond,	106	
Mill Pond at East Blackstone,	20	Mill River.

MIDDLESEX COUNTY (Total No. of acres, 8,743).

NAME.	Area in acres.	Outlet.
Ashby.		
Reservoir,	87	Willard Brook.
Neesepogesuck P'ds,	22	Pearl Hill Br'k.
Townsend.		
Harbor Pond,	95	
Pond, southwest of the above,	12	Squannacook River.
Reservoir,	22	
Tyngsborough.		
Massapoag Pond,	56	
Pond, south of the above,	12	Salmon Brook.
Tyng's Pond,	228	Merrimac River.
Mud Pond,	46	
Dracut.		
Part of Lond Pond,	114	Beaver River,
Merrimac Mills P'nd,	12	Merrimac River.
Peters Pond,	104	

NAME.	Area in acres.	Outlet.
Shirley.		
Paper Mill Pond,	44	Squannacook River.
Squannacook Pond,	13	
Dead Pond,	16	None.
Pond, northeast of the above,	22	Catacoonamug River.
Ayer.		
Ames Plow Company's Pond,	45	
Sandy Pond,	80	Nonacanicus Brook.
Pond, west of the above,	115	
Lond Pond,	45	
Pond in southeast corner,	10	Bennett's Br'k.
Groton.		
Martin's Pond,	31	Martin's Pond Brook.
Baddacook Pond,	103	Baddacook B'k.
Whitney's Pond,	71	Cow Pond Br'k.

MIDDLESEX COUNTY—Continued.

Name.	Area in acres.	Outlet.
Knop's Pond,	55	Martin's Pond Brook.
Dick Pond,	55	None.
Westford.		
Sought-for Pond,	106	
Keyes Pond,	20	
Nabnassett Pond,	98	
Pond, west of the above,	13	Stony Brook.
Burge Pond,	22	
Forge Pond,	143	
Chelmsford.		
Newfield Pond,	80	Stony Brook.
Hart Pond,	105	River Meadow Brook.
Tewksbury.		
Long Pond,	43	Shawsheen Riv.
Round Pond,	28	Strongwater Brook.
Littleton.		
Spectacle Pond,	71	Stony Brook.
Pond, west of vil'ge,	40	Beaver Brook.
Long Pond,	78	Long Pond B'k.
Fort Pond,	104	
Nagog Pond,	220	Nashoba Br'k.
Boxborough.		
Withington Pond,	37	Assabet Brook.
Acton.		
Grassy Pond,	33	Long Pond B'k.
Pond in northeast part,	11	Nashoba Brook.
Pond, southeast p'rt,	10	None.
Concord.		
Bateman's Pond,	20	Assabet River.
White Pond,	53	Sudbury River.
Walden Pond,	80	None.
Fair Haven Bay,	60	Sudbury River.
Billerica.		
Winnings' Pond,	10	Concord River.
Nutting's Pond,	90	
Wilmington.		
Silver Lake,	37	Ipswich River.
Burlington.		
Pond in northeast corner,	10	Ipswich River.
Pond on line of Lexington,	10	Vine Brook.
Woburn.		
Pond, east of North Woburn,	31	
Pond at E. Woburn,	14	Mystic River.
Horn Pond,	91	
North Reading.		
Martin's Pond,	136	Martin's Brook.
Swan Pond,	86	Ipswich River.
Pond on Ipswich River,	23	
Wakefield.		
South Reading P'nd,	264	Saugus River.
Crystal Lake,	48	
Stow.		
Boon's Pond,	100	Assabet River.
Pond in the Assabet River,	283	

Name.	Area in acres.	Outlet.
Hudson.		
White Pond,	46	Assabet River.
Marlborough.		
Fort Meadow Res'v'r,	250	Fort Meadow Brook.
Williams Pond,	100	Assabet River.
Maynard.		
Assabet Mill Pond,	19	Assabet River.
Puffer's Pond,	41	
Sudbury.		
Willis Pond,	74	Assabet River.
Bottomless Pond,	21	None.
Pond on Hop Brook,	13	Hop Brook.
Blandford Pond,	22	Wash Brook.
Pond, north of the above,	11	
Wayland.		
Pelham Pond,	75	Sudbury River.
Dudley Pond,	86	None.
Lincoln.		
Sandy Pond,	114	Stony Brook.
Two ponds in northeast part,	30	Hobbs Brook.
	20	None.
Beaver Pond,	112	Stony Brook.
Winchester.		
Winter Pond,	24	None.
Wedge Pond,	67	Mystic River.
Pond in northeast part,	15	
Stoneham.		
Doleful Pond,	13	Malden River.
Spot Pond,	220	
Malden.		
Pond in Malden Centre,	10	Malden River.
Melrose.		
Pond in centre,	30	Malden River.
Long Pond,	10	Saugus River.
Hopkinton.		
Whitehall Pond,	620	Sudbury River,
North Pond,	81	Mill River.
Holliston.		
Pond at East Vil'ge,	24	
Pond, southeast of the above,	14	Jar Brook.
Winthrop Pond,	125	
Ashland.		
Pond in west part,	16	
Pond in centre,	18	Sudbury River.
Pond, southeast of the above,	18	
Framingham.		
Farm Pond,	168	Sudbury River.
Learned's Pond,	42	None.
Gleason's Pond,	10	Steep Brook.
Shakum Pond,	93	
Sherborn.		
Farm Pond,	100	Charles River.
Natick.		
Lake Cochituate,	600	Cochituate Br'k.
Pickerel Pond,	10	Charles River.
Pond in east part,	11	

MIDDLESEX COUNTY—Concluded.

Name.	Area in acres.	Outlet.
Dug Pond, . . .	46	
Pond, north of the above, ...	58	Cochituate Br'k.
Pond on Steep Br'k,	12	
Nonesuch Pond, .	48	Charles River.
Waltham.		
Means Pond, . .	52	Beaver Brook.
Newton.		
Pond, north of Newtonville, . .	12	None.
Wiswall's Pond, .	27	
Hammond's Pond, .	28	Charles River.

Name.	Area in acres.	Outlet.
Arlington.		
Mystic Pond, . .	232	
Pond, southwest of the above, . .	13	Mystic River.
Spy Pond, . .	150	
Belmont.		
Pond, south of Spy Pond, . . .	34	
Ice Pond, . . .	35	Mystic River.
Fresh Pond, . .	175	
Brighton.		
Chestnut Hill Res'v'r,	125	Boston Water Works.

ESSEX COUNTY (Total No. of acres, 4,570).

Name.	Area in acres.	Outlet.
Methuen.		
Harris Pond, . .	39	Spickett River.
Mystic Pond, . .	29	
Lawrence.		
Pond in northwest part, . . .	12	Spickett River.
Haverhill.		
Creek Pond, . .	156	
Round Pond, . .	41	
Plug Pond, . .	21	
Great Pond, . .	238	Merrimac River.
Pond on line of Amesbury, . .	33	
Bradford.		
Little Pond, . .	107	Merrimac River.
Amesbury.		
Pond at River Vil'ge,	14	Merrimac River.
Kimball's Pond, .	408	
Pond on the State line, . . .	50	Powow River.
Bailey's Pond, . .	150	Merrimac River.
Andover.		
Haggett's Pond, .	152	Fish Brook.
Pomp's Pond, . .	17	Shawsheen Riv.
Foster's Pond, . .	40	
North Andover.		
Great Pond, . .	645	Cochituate B'k.
Boxford.		
Hovey's Pond, . .	36	Merrimac River.
Johnson's Pond, .	194	
Stiles' Pond, . .	60	Fish Brook.
Wood Pond, . .	22	Pye Brook.
Perley's Pond, . .	54	Penn Brook.
Four-Mile Pond, .	42	Pye Brook.
Cedar Pond, . .	13	Fish Brook.
Spofford's Pond, .	13	Pye Brook.
Groveland.		
Crane Pond, . .	15	Parker River.
Georgetown.		
Rock Pond, . .	43	Parker River.
Puntucket Pond, .	43	
West Newbury.		
Crane-Neck Pond, .	10	Parker River.
Ipswich.		
Pritchard's Pond, .	93	Pye Brook.

Name.	Area in acres.	Outlet.
Middleton.		
Middleton Pond, .	98	Ipswich River.
Lynnfield.		
Pillings Pond, .	83	Saugus River.
Suntaug Lake, .	210	Noyes Brook.
Peabody.		
Cedar Pond, . .	18	Goldthwait's Brook.
Brown's Pond, .	54	Tapley's Brook.
Saugus.		
Pond in north part,	25	Saugus River.
Pond in centre, .	75	
Lynn.		
Cedar Lake, . .	35	
Wyoma Lake, . .	84	Stony Brook.
Wenuchus Lake, .	117	
Glenmere Lake. .	15	Stacey's Brook.
Mill Pond, in west part, . . .	25	Beaver Brook.
Salem.		
Linmere Pond, .	102	Tapley's Brook.
Beverly.		
Beaver Pond, . .	20	None.
Hamilton.		
Beck's Pond, . .	26	
Gravel Pond, . .	30	Essex River.
Round Pond, . .	30	
Wenham.		
Muddy Pond, . .	18	None.
Pleasant Pond, .	38	Ipswich River.
Cedar Pond, . .	16	Mile River.
Wenham Lake, .	255	
Coy's Pond, . .	36	Essex River.
Essex.		
Chebacco Pond, .	260	Essex River.
Manchester.		
Beaver Dam Pond, .	16	Baker's Brook.
Gloucester.		
Coffin's Pond, . .	12	Jones' River.
Ocean Pond, . .	35	None.
Rockport.		
Pond in west part, .	49	- -

NORFOLK COUNTY (Total No. of acres, 4,350).

Name.	Area in acres.	Outlet.
Needham.		
Morse's Pond,	38	Charles River.
Lake Wauban,	120	
Pond, near centre,	20	Rosemary Br'k.
Reservoir, northeast part,	27	Charles River.
West Roxbury.		
Jamaica Pond,	56	None.
Brookline.		
Reservoir,	23	Boston Water [Works.
Dover.		
Reservoir Pond,	25	Chelsea River.
Dedham.		
Buckminster Pond,	31	Bubbling Br'k.
Pond in northwest part,	10	Charles River.
Wigwam Pond,	32	
Sprague Pond,	11	None.
Mill Pond in south part,	20	Bubbling Br'k.
Hyde Park.		
Mill Pond at Readville,	12	Mother Brook.
Milton.		
Houghton Pond,	28	Blue Hill River.
Medway.		
Pond, northeast part,	26	Charles River.
Norfolk.		
Populatic Pond,	74	Charles River.
Kingsbury Pond,	20	None.
City Mills Pond,	12	Mill River.
Bush Factory Pond,	14	
Pond, south of the centre,	14	Stony Brook.
Walpole.		
Pond, northwest of centre,	23	Neponset Riv.
Pond at E. Walpole,	21	
Bellingham.		
Beaver Pond,	108	
Pond, northwest of N. Bellingham,	12	
Pond, northeast of N. Bellingham,	10	
Pond, south of N. Bellingham,	93	Charles River.
Pond, north of Bellingham Centre,	18	
Pond, west of Bellingham Centre,	27	
Jenks Reservoir,	42	Peters River.
Franklin.		
Beaver Pond,	18	Mine Brook.
Pond, north of the above,	31	
Dr. Miller's Reservoirs,	25	Mill River.
Pond in southeast part,	12	
Wrentham.		
Stony Brook Resv'r,	75	Stony Brook.
Archer's Pond,	94	None.
Whiting's Pond,	244	Mill River.
Shepard's Pond,	252	
Pond, southwest of the above,	20	Wading River.
Pond, northwest of Shepard's Pond,	17	
Foxborough.		
Pond, near South Walpole,	14	Neponset River.
Neponset Reservoir,	365	
Pond, northwest of centre,	62	
Reservoir, south of the above,	28	
Cocasset Pond,	40	Cocasset River.
Reservoir, northwest of the above,	25	
Pond, south of Cocasset Pond,	22	
Two ponds west of Neponset Res'v'r,	12, 10	Neponset River.
Pond, northeast of Shepard's Pond,	14	Cocasset River.
Pond, south of Shepard's Pond,	20	None.
Pond, southeast of Foxboro' Centre,	12	Rumford River.
Pond, near East Foxborough,	13	
Sharon.		
Wolomolopoag P'd,	36	Rumford River.
Massapoag Pond,	460	Massapoag B'k.
Pond, near Bear-Foot Hill,	10	Rumford River.
Reservoir Pond,	17	PequanticutRiv.
Pond on Foxboro' line,	10	Canoe River.
Canton.		
Ponkapog Pond,	208	Ponkapog Br'k.
Reservoir Pond,	209	
Forge Pond,	26	Massapoag B'k.
Bolivar Pond,	20	
Muddy Pond,	10	None.
Stoughton.		
York Pond,	10	Beaver Brook.
Pond, west of centre,	19	
Pond, northwest of the above,	10	Massapoag B'k.
Muddy Pond,	10	
Ames Pond,	127	Queset Brook.
Braintree.		
Great Pond,	150	Farm River.
Cranberry Pond,	25	Cranberry B'k.
Weymouth.		
Whitman's Pond,	247	Weymouth Ba'k [River.
Whortleberry Pond,	12	Mill River.
Great Pond,	288	
Cohasset.		
Scituate Pond,	53	– –

Bristol County (Total No. of acres, 7,961).

Name.	Area in acres.	Outlet.
Attleborough.		
Pond, north of North Attleborough,	48	
Pond, east of North Attleborough,	11	Ten-Mile River.
Bungay Reservoir,	118	Bungay Brook,
Pond at Falls Vil'ge,	140	
Pond, east of above,	21	Ten-Mile River.
Pond, south of Robinsonville,	11	
Pond, east of Attleborough depot,	19	Wading River.
Dodgeville Pond,	55	Ten-Mile River.
Pond at Attleboro' City,	31	City Brook.
Pond at Hebronville,	70	Ten-Mile River.
Pond in southeast part,	32	Wading River.
Mansfield.		
Pond at Robinsonville,	10	
Pond, south of Robinsonville,	35	Wading River.
Pond, southwest of West Mansfield,	20	
Pond at Mansfield Junction,	10	
Fulton's Pond,	17	
Kingman & Hodges Pond,	15	
Pond, south of the last,	20	Rumford River.
Grist and Saw-Mill Pond,	19	
Pond, west of Whiteville,	30	Canoe River.
Pond at E. Mansfield.	30	
Norton.		
Buttomennumonthe Pond,	615	
Pond, north of the centre,	12	
Pond, southeast of the centre,	17	
Pond at Barrowsville,	23	Rumford River.
Pond, southwest of Barrowsville,	23	
Pond, east of Barrowsville,	20	
Brass Furnace P'nd,	25	
Winnicunnet Pond,	122	Canoe Brook.
Easton.		
Wilbur Pond,	197	Pequanticut Riv.
Flyaway Pond,	70	
Lower Pond, at N. Easton,	26	
Upper Pond, at S. Easton,	33	Queset Brook.
Lower Pond, at S. Easton,	14	
Pond, south of the centre,	35	Black Brook.
Pond, north of Furnace Village,	12	
Pond, west of the above,	45	
Pond, south of Furnace Village,	10	Mulberry Mead. River.
Pond, southeast of the above,	12	

Name.	Area in acres.	Outlet.
Raynham.		
Smooch Hill Pond,	12	
Gushee Pond,	60	
King's Pond,	20	
Pond, above Raynham Centre,	26	Two-Mile River.
Pond, below Raynham Centre,	26	
Pond, south of the above,	11	
Seekonk.		
Pond on Pawtucket line,	18	Ten-Mile River.
Pond in northeast corner,	25	
Rehoboth.		
Reservoir,	86	Palmer River.
Pond in southwest part,	24	
Pond on Swansey line,	11	Rocky River.
Swansey.		
Factory Pond,	20	Cole's River.
Pond, southwest of the above,	14	
Taunton.		
Watson's Pond,	78	Mill Creek.
Scadden's Pond,	225	
Prospect Hill Pond,	63	None.
Britanniaville Pond,	15	Mill Creek.
Hopewell Pond,	10	
Pond at Oakland,	20	Three-Mile Riv.
Mill Pond, below Westville,	55	
Pond, southwest of Squawhetty,	23	Cotley River.
Pond, south of the above,	13	
Furnace Pond,	125	
Robinson and Kings Pond,	30	Taunton River.
Dean Factory Pond,	40	
Pond, near Myrick's,	11	Cotley River.
Fall River.		
North Watuppa P'd,	1,490	Mt. Hope Bay.
Cook's Pond,	90	
Freetown.		
Forge Pond,	60	Quaker Brook.
Pond in E. Freetown,	10	Fall Brook.
Westport.		
South Watuppa P'd,	2,007	
Sandy Pond,	352	Mt. Hope Bay.
Devoll's Pond,	62	
Dartmouth.		
Pond, near Freetown line,	23	Shingle Island River.
Hicksville Pond,	23	
Turner's Mills Pond,	48	Fresh River.
Westport Mills P'd,	127	Shingle Island River.
Pond, northwest of the above,	67	
Pond at North Dartmouth,	60	
Pond, near Deerfield Swamp,	27	Fresh River.

BRISTOL COUNTY—Concluded.

Name.	Area in acres.	Outlet.
New Bedford.		
Sassaquin's Pond,	51	Fresh River.
Acushnet.		
City of New Bedford Reservoir,	280	Acushnet River.
Pond, near centre of town,	34	Acushnet River.
Pond at Acushnet Village,	16	
Pond on line of Mattapoisett,	30	Mattapoisett River.

PLYMOUTH COUNTY (Total No. of acres, 17,623).

Name.	Area in acres.	Outlet.
North Bridgewater.		
Pond west of vil'ge,	25	Salisbury Plain River.
Pond east of vil'ge,	10	
Abington.		
Pond northwest corner of town,	11	Beaver Brook.
Pond south of East Abington,	32	Indian Head River.
Pond at Abington Centre,	49	
Pond northeast of South Abington,	25	Poor Meadow.
Pond east of the above,	22	
Hingham.		
Cushing's Pond,	30	
Pond southeast of the above,	18	Weir River.
Accord Pond,	90	
Pond east part of Hingham,	12	
Hanover.		
Pond in northwest part,	13	Indian Head River.
Pond in southwest part,	24	
South Scituate.		
Pond, near Assinippi Village,	50	Third Herring Brook.
Black Pond,	17	
Dead Swamp Pond,	23	Second Herring Brook.
Pond, South Scituate Village,	12	
East Bridgewater.		
Pond northwest p't,	19	
Pond south of the above,	23	
Pond, west of the Centre,	20	
Lower Pond, northeast of village,	20	Matfield River.
Middle Pond, northeast of village,	14	
Upper Pond, northeast of village,	16	
Pond northeast of Joppa,	15	
Robbins Pond,	140	Satucket River.
Pond, north of the above,	11	
Hanson.		
Pond at N. Hanson.	40	Poor Meadow River.
Pond southwest of the above,	46	
Pond on line of Hanover,	27	Indian H'd Riv.

Name.	Area in acres.	Outlet.
Maquan Pond,	57	
Pond west of the above,	90	Indian H'd Br'k.
Indian Head Pond,	156	
Pembroke.		
Upper Pond, on line of Hanover,	25	North River.
Lower Pond, on line of Hanover,	16	
Pond northeast of centre,	11	
Oldham Pond,	237	Herring Brook.
Furnace Pond,	120	
Great Sandy Pond,	100	
Hobamock Pond,	15	None.
Little Sandy Pond,	65	Herring Brook.
Stetson P nd,	93	Satucket River.
Jones River Pond,	728	
Lower Pond, on line of Duxbury,	39	Jones River.
Upper Pond, on line of Duxbury,	13	
Marshfield.		
Pond south of South Marshfield,	16	South River.
Duxbury.		
Pond northwest p't,	10	South River.
Round Pond,	11	
Island Creek Pond,	72	Island Creek.
Bridgewater.		
Nunkatesett Pond,	16	
Nippenicket Pond,	388	Town River.
Pond southeast of the centre,	42	
Pond northeast part,	33	Taunton River.
Pond southwest p't,	14	
Halifax.		
Monponsett Pond,	743	Satucket River.
Pond on line of Pembroke,	20	None.
Pond in southwest part,	14	
Pond in south cor.,	29	
Pond north of the above,	45	Winetuxet Riv.
Pond south of Monponsett Pond,	31	
Plympton.		
Pond in south cor.,	25	Whetstone Br'k.
Kingston.		
Pond near corner of Duxbury and Pembroke,	10	
Blackwater Pond,	29	Jones River.
Crosman's Pond,	15	

PLYMOUTH COUNTY—Concluded.

Name.	Area in acres.	Outlet.
Pond southeast of the above,	15	Jones River.
Great Indian Pond,	91	None.
Muddy Pond,	61	
Smelt Pond,	92	Smelt Brook.
Lakeville.		
Pond, north of T. & M. Railroad,	11	Taunton River.
Dunham's Pond,	10	None.
Clear Pond,	21	
Elder's Pond,	167	Namasket Riv.
Long Pond, north of above,	20	None.
Long Pond, on line of Freetown,	1,760	Namasket Riv.
Little Quittacas P'd,	360	
Great Quittacas P'd,	1,255	Mattapois't Riv.
Pocksha Pond,	497	Namasket Riv.
Assowonipsett P'nd,	2,220	
Middleborough.		
Pond in Waterville,	27	Whetstone B'k.
Wood's Pond,	45	Fall Brook.
Tispaquin Pond,	175	
Benson's Pond,	11	Sampson's Br'k.
Pond north of the above,	14	
Carver.		
Muddy Pond,	50	Winetuxet Br'k.
Cooper's Pond,	40	None.
John's Pond,	16	Winetuxet Br'k.
Wenham Pond,	37	S. Meadow B'k.
Vaughan Pond,	13	None.
Dunham Pond,	40	Sampson's Br'k.
Pond southeast of the above,	55	
Federal Pond,	100	
Sampson's Pond,	234	
Cedar Pond,	30	None.
Clear Pond,	12	
Barrett's Pond,	12	
Plymouth.		
North Triangle P'd,	10	None.
Darby Pond,	51	S. Meadow B'k.
Muddy Pond,	14	
Clear Pond,	12	None.
Billington Sea,	306	– –
Lout Pond,	18	None.
West Pond,	75	
Micajah's Pond,	10	
King's Pond,	15	
Pond west of the above,	19	
Cook's Pond,	21	
South Triangle P'd,	20	
Little South Pond,	54	Eel River.
Grassy Pond,	14	None.
Great South Pond,	318	Eel River.
Boot Pond,	74	
Jenkins Hole,	19	None.
Gunner's Exchange Pond,	98	
Russell Mills Pond,	52	Eel River.
Old Colony Duck Company Pond,	14	
Beaver Dam Pond,	115	Beav'r Dam B'k.
Fresh Pond,	57	None.
Little Island Pond,	15	
Shallow Pond,	15	
Island Pond,	82	
Clam Pudding Pond,	10	
Wiggin's Pond,	25	

Name.	Area in acres.	Outlet.
Pond, northwest of the above,	15	None.
Clew Pond,	50	
Dunham Pond,	12	
Rocky Pond,	32	Sampson's Br'k.
Furnace Pond,	48	
College Pond,	50	None.
Three-Cornered P'd,	20	
Long Pond, near the above,	44	
Bump's Pond,	16	
Little Long Pond,	54	
Gallows Pond,	43	
Half-Way Pond,	223	Agawam River.
Long Pond, near the above,	240	None.
Bloody Pond,	93	
Savery's Pond,	56	– –
Fearing Pond,	65	None.
Fawn Pond,	20	
Charge Pond,	45	
Lond Pond, on line of Wareham,	20	
Five-Mile Pond,	23	
White Island Pond,	396	Reed Brook.
Sandy Pond,	121	None.
Ezekiel's Pond,	38	
Little Sandy Pond,	11	
Little Herring Pond,	70	Monument Riv.
Herring Pond,	435	
Rochester.		
Snippatuit Pond,	885	Mattapois'tt Riv.
Long Pond,	33	None.
Snow's Pond,	82	
Pond southwest of the above,	76	Mattapois'tt Riv.
Cary's Pond,	92	Sippican River.
Pond west of the above,	59	
Pond south of Cary's Pond,	96	
Marion.		
Pond near Lawrence Swamp,	12	Mill Creek.
Wareham.		
West Wareham P'd,	45	Weweantic Riv.
Pond south of West Wareham,	23	
Pond southeast of the above,	28	
Blackmore Pond,	55	Sippican River.
Pond north of Blackmore Pond,	92	Weweantic Riv.
Pond northwest of the above,	23	
Pond at Tihonet,	97	Frog-Foot Riv.
Pond west of the above,	20	
Pond near Wareham Narrows,	62	Wancinco Riv.
Flax Pond,	31	None.
Pond northwest of Flax Pond,	112	Agawam River.
Beaver Dam Pond,	20	– –
Swift's Pond,	50	– –
Sturtevant's Pond,	13	None.
Cedar Pond,	13	
Spectacle Pond,	85	
Pickerel Pond,	23	
Glen Mill Pond,	65	Agawam River.
Bartlett's Marsh P'd,	55	

BARNSTABLE COUNTY (Total No. of acres, 9,721).

NAME.	Area in acres.	Outlet.
Sandwich.		
Ellis Pond,	25	– –
Pond southwest of Sandwich Village,	47	Mill River.
Queen Sowett Pond,	14	None.
Bourne Pond,	13	
Mill Pond,	57	Back River.
Deep Bottom Pond,	34	None.
Flax Pond,	64	
Upper P'd, Pocassett,	20	Barlow River.
Lower P'd, Pocassett,	10	
Pond southwest of Flax Pond,	21	
Pond in S. Pocasset,	22	
Long Pond,	28	
Succonnessett P'ds,	12 12	
Weeks' Pond,	12	None.
Snake Pond,	76	
Peters Pond,	176	
Spectacle Pond,	151	
Triangle Pond,	84	
Lawrence Pond,	70	
Two ponds at East Sandwich,	12 12	– –
Falmouth.		
Pond at North Falmouth,	25	– –
Pond southwest of North Falmouth,	26	– –
Deep Pond,	34	None.
Coonemossett Pond,	100	– –
Crooked Pond,	73	
Shallow Pond,	12	
Jenkins Pond,	42	None.
Spectacle Pond,	20	
Mare's Pond,	38	
Long Pond,	205	
Fresh Pond,	42	– –
Ponds northeast of Falmouth Village,	10 11 16	None. – – None.
Factory Pond, north of East Falmouth,	19	– –
Pond east of the above,	15	– –
Mashpee.		
Pimlico Pond,	14	None.
Wakeby Pond,	375	Marshpee River.
Marshpee Pond,	395	
Santuit Pond,	170	Cotuit River.
Ashumet Pond,	226	None.
John's Pond,	240	
Barnstable.		
Pond, south of West Barnstable,	18	Scorton Creek.
Spruce Pond,	12	Bridge Creek.
Steward's Pond,	36	None,
Long Pond, in west part,	63	
Pond at Newtown,	25	– –
Shubael Pond,	50	
Pond south of the above,	13	None.
Pond southwest of Shubael Pond,	126	
Pond north of the above,	118	– –
Pond west of the Plains,	147	None.
Pond northwest of the above,	11	

NAME.	Area in acres.	Outlet.
Lovell's Pond,	48	None.
Two ponds north of Osterville,	14 15	
Mill Pond west of Centreville,	16	– –
Pond north of the above,	12	– –
Great Pond,	700	
Shallow Pond,	90	
Hathaway's Pond,	15	
Pond north of the above,	21	
Israel's Pond,	21	
Small Pond,	22	None.
Half-Way Pond,	12	
Lewis Pond,	10	
Two ponds west of Hyannis,	12 10	
Long Pond, near Centreville,	69	
Yarmouth.		
Dennis Pond,	50	
Long Pond, near the above,	11	None.
Taylor's Pond,	39	
Flax Pond,	20	
Mill Pond,	81	Hamblin Brook.
Flax P'nd, near west Yarmouth,	15	None.
Pond west of the above,	50	Thornton Br'k.
Horn Pond,	14	None.
Plashes Pond,	65	Parker's River.
Swan Pond,	70	
Long Pond, near S. Yarmouth,	94	None.
Pond, south of Long Pond,	20	
Three ponds near South Dennis,	12 10 13	– – None.
Dennis.		
Scargo Lake,	60	Sesuet Creek.
Flax Pond,	20	
Run Pond,	20	
Simmons Ponds,	22 11	
Grassy Pond,	22	None.
Pond on line of Harwich,	23	
Pond southwest of the above,	20	
Swan Pond,	179	Swan Pond Riv.
Pond northwest of the above,	10	None.
Pond southeast of South Dennis,	29	
Pond southwest of West Dennis,	25	– –
Brewster.		
Mill Pond,	365	Herring River.
Pond east of Mill Pond,	54	
Pond south of Mill Pond,	51	None.
Two ponds west of Mill Pond,	25 34	
Pond northwest of Mill Pond,	23	Quivett Creek.
Pond north of Mill Pond,	22	None.

BARNSTABLE COUNTY (Concluded).

NAME.	Area in acres.	Outlet.
Pond N. of Brewster Village,	21	- -
Griffith's Pond,	32	None.
Bang's Pond,	130	Herring River.
Long Pond,	778	
Sheep Pond,	132	None.
Pond northwest of Long Pond,	20	
Two ponds east of Long Pond,	12 60	
Two ponds south of East Brewster,	17 22	
Cliff Pond,	141	
Two ponds north of Cliff Pond,	40 13	
Two ponds east of Cliff Pond,	16 44	
Three ponds south of Cliff Pond,	15 11 15	
Harwich.		
Hinckley's Pond,	153	Herring River.
Island Pond,	21	
Grass Pond,	74	- -
Pond northeast of the above,	15	None.
Skinequit Pond,	20	Red River.
Hawk's Nest Pond,	60	None.
Pond W. of Hawk's Nest Pond,	27	
Two ponds south of Hawk's Nest P'd,	23 16	
Pond northeast of Hawk's Nest P'd,	26	
Chatham.		
Goose Pond,	66	None.
Four ponds west of Goose Pond,	15 11 29 13	
Pond, southwest p'rt,	14	- -
Pond, southwest of West Chatham,	15	- -
Two ponds east of Goose Pond,	14 25	None.
Two ponds southwest of Great Hill,	10 31	
Pond, northwest of Great Hill,	24	- -
Pond, north of the above,	13	- -
Orleans.		
Baker's Pond,	88	None.
Pond, south of Orleans Village,	43	
Pond, southeast of the above,	53	
Pond, east of the village,	11	
Pond in south part,	18	
Eastham.		
Pond, northwest cor.	10	None.
Pond, north of centre,	17	
Great Pond,	112	
Pond, east of Great Pond,	39	
Herring Pond,	45	
Wellfleet.		
Herring Pond,	19	Herring River.
Higgins Pond,	25	
Gull Pond,	95	None.
Long Pond,	34	
Great Pond,	42	
Hopkins Pond,	10	
Truro.		
Mill Pond,	17	Pamet River.
Higgins Pond,	17	None.
Pond, north of Higgins Pond,	14	
Newcomb's Pond,	32	
Long Pond,	28	
Provincetown.		
Great Pond,	45	None.
Black-Water Pond,	11	
Pasture Pond,	14	
Clapp's Round P'nd,	10	
Duck Pond,	20	
Clapp's Pond,	72	
Shank Painter P'nd,	83	

DUKES COUNTY (Total No. of acres, 90).

Name.	Area in acres.	Outlet.
Gosnold.		
Pond, west part of Naushon,	65	None.
Pond, east past of Nashawena,	25	None.

NANTUCKET COUNTY (Total No. of acres, 33).

Nantucket.

Gibbs' Pond, ... 33 acres—No ontlet.

RECAPITULATION.

Berkshire County,	6,226
Franklin County,	2,184
Hampshire County,	2,282
Hampden County,	4,148
Middlesex County,	8,743
Worcester County,	25,007
Essex County,	4,570
Norfolk County,	4,350
Bristol County,	7,961
Plymouth County,	17,623
Barnstable County,	9,721
Dukes County,	90
Nantucket County,	33
Total area of ponds (area over 10 in acres) in Massachusetts,	92,938

Additional Analysis of Evidence as to the Use and Abuse of Intoxicating Liquors.

BEER-SHOPS AND PROHIBITORY LAWS.

By P. EMORY ALDRICH,

MEMBER OF THE STATE BOARD OF HEALTH.

BEER-SHOPS AND PROHIBITORY LAWS.

The fourth section of the "Act to establish a State Board of Health" declares that "It shall be the duty of the board, and they are hereby instructed to examine into and report what, in their judgment, is the effect of the use of intoxicating liquor, as a beverage, upon the industry, prosperity, happiness, health and lives of the citizens of the State. Also, what additional legislation, if any, is necessary in the premises." This Act was passed in the year 1869. The Board, through its chairman, early entered upon an extensive correspondence with persons in this and foreign countries, who from their official or professional positions, were supposed to be peculiarly qualified to communicate important and authentic information to guide the Board in the discharge of that part of its duty set forth in the section of the law above cited. This correspondence was published with the report of the board for the year 1871. The Third Annual Report of the Board contains an "Analysis," by the Chairman, "Of the Correspondence on the Use and Abuse of Intoxicating Drinks throughout the globe, which was presented to the legislature in 1871, or Intemperance as seen in the light of Cosmic Law."

That analysis, or as it may properly be called essay, attracted very general attention among those who were ready to adopt the views expressed by the author, as well as among those who dissented from some of his conclusions. The portions of that essay which have encountered the most adverse criticism, are those in which the writer expresses the "belief that the permission to sell mild ales, beer and light wines would, under certain very general rules, be really a promotion of temperance in New England, as it apparently is elsewhere." That "light German beer and ale can be used even freely without any very apparent injury to the individual, or without causing intoxication." That "light grape-wines,

unfortified by an extra amount of alcohol, can be drunk less freely without injury to the race, and with exhilaration rather than drunkenness. Some writers think they do no harm, but a real good if used moderately. They never produce the violent, crazy drunkenness, so noticeable from the use of the ardent spirits of the North." That "the example set by California and Ohio should be followed by the whole country, where the vine can be grown. As a temperance measure, it behooves any good citizen to promote that most desirable object. We should also allow the light, unfortified wines of Europe to be introduced free of duty, instead of the large one now imposed. Instead of refusing the German lager beer, we should seek to introduce it into the present "grog-shops," and thus substitute a comparatively innoxious article for those potent liquors, which now bring disaster and death into so many families."

From the last sentence quoted, as well as from the general tenor of his discussion, the author of the "analysis" can have no sympathy with the manner in which the beer-shops are now conducted in this Commonwealth, or be found among the advocates of their continuance; for as the governor in his late annual message declares, "A beer-shop, so called, has come to mean generally, a place where all kinds of intoxicating liquors are furnished; and nine-tenths of them, as the chief constable of the Commonwealth affirms, use their licenses as a cover for the sale of distilled spirits."

The Board, acting as they believed, in accordance with the spirit of the law defining their duties, presented the "analysis" prepared by their Chairman "as a valuable contribution to the discussion of the general subject of the use and effect of intoxicating drinks, *but without expressing, as a Board, any opinion concerning the inferences made by the writer, or on the special methods advocated by him.*"

And now, without attempting to commit the Board to any peculiar views of my own, I propose to submit a further analysis of evidence contained in written and printed documents received from the correspondents of the Board and from other authentic sources, bearing upon the two questions as to the effect of restrictive legislation upon the sale of intoxicating liquors and the establishment of beer-shops.

And first, What in the light of experience and observation has been the effect of beer-shops upon "the industry, prosperity, happiness, health and lives" of the people?

One of the most important documents in the possession of the Board upon this subject, is a printed "Report by the Committee on Intemperance for the Lower House of Convocation of the Province of Canterbury," England. This report was made in the year 1869. The committee that made the report was appointed "To consider and report on the prevalence of Intemperance, the evils which resulted therefrom, and the remedies which may be applied." The Province of Canterbury embraces thirty-two English counties, and North and South Wales, and contained a population at the date of the report of 14,071,164. The territory and population covered, by the statistics upon which the report is based, will be seen therefore to have been large. Full and minute inquires as to: 1, The extent of the evil of intemperance; 2, probable causes; 3, results; and 4, remedies, were addressed by the committee to the (1) clergy of the province; (2) to the recorders of England and Wales; (3) governors and chaplains of prisons throughout Great Britain; (4) chief constables and superintendents of police throughout Great Britain; (5) superintendents of lunatic hospitals throughout England and Wales; (6) coroners throughout England and Wales; (7) governors of workhouses throughout England and Wales.

Replies were received from the persons addressed, to the number in all of twenty-two hundred and eighty-three, and one of the "results" of intemperance as shown by the unvarying testimony of persons having the fullest means of correct information, was that from three-fourths to nine-tenths of the crime and poverty existing in the province could be traced to the intemperate use of intoxicating liquors. But it is aside from the present purpose to dwell upon this aspect of the great and intolerable evil of intemperance; and I proceed at once to examine the evidence found in this remarkable report, bearing upon the question as to whether *beer-shops are or not a cause of intemperance.*

The committee, in presenting their report of the evidence they have with so much industry accumulated, affirm that of

"the direct causes of our national intemperance, one of the foremost and the most prolific, as it appears to your committee is, the operation of the legislative Act which called beer houses into existence, and placed the power of licensing them in the hands of the excise. This measure, though introduced in 1830 *for the avowed purpose of repressing intemperance by counteracting the temptations to the excessive drinking of ardent spirits afforded in public houses, has been abundantly proved, not only to have failed of its benevolent purpose, but to have served throughout the country to multiply and intensify the very evils it was intended to remove.*" And the committee add: "It is a fact worthy of record, that the late Lord Brougham, who anticipated the spread of sober habits from the beer-shop system, was eventually so impressed with its multiplied evils, that he introduced into the House of Lords a bill for the repeal of the Beer Act, and succeeded in inducing the peers to assent to a resolution affirming the principle of his measure."

These statements of the committee are fully sustained by the testimony they publish :—

1. Of Clergymen.

"The Duke of Wellington's Beer-House Act was the origin of much of the existing evil."

"Intemperance much increased since beer-shops were introduced some years ago, especially among young men."

"The beer-houses are an unmitigated nuisance."

"Intemperance has increased here with the number of beer-shops."

"The Act permitting beer-shops is here, and I think everywhere, a curse."

"The beer-houses are a great evil."

"The increase of intemperance is entirly owing to the setting up of first one, and afterward a rival beer-shop. I do not see how any thoughtful person, who cares for the well-being of the poor, can feel otherwise than that the State, by its encouragement of the multiplication of the beer-shops, commits a great national sin, which must one day be punished by a national retribution."

"If I am asked to point out the great cause and encouragement of intemperance, I have no hesitation in ascribing it, in a great measure, to that most disastrous Act of parliament which set beer-shops on foot."

"*No public-house or beer-shop.—No intemperance.*—With reference to intemperance in other parishes, I have no doubt that it is largely increased by the low beer-houses."

"Intemperance very much *decreased* by the influence of the landlord shutting up a beer-shop which formerly did much mischief."

"To my sorrow there are two beer-shops in this parish, neither of which has been established any great number of years. I have no doubt as

to their influence. Many families in which the wives and children were formerly well clad and apparently well fed, have, since the introduction of the beer-shops, been in rags and poverty-stricken. I have been here thirty years, during the greater part of which there was no beer-shop in the parish; I have, therefore, every opportunity of observing the effects either for good or evil, and I can come to no other conclusion than that the beer-shops, as at present conducted, are the very sinks of iniquity and vice."

Testimony of Coroners.

"In my opinion, beer-shops are a crying evil in rural districts."

"Beer-houses a great source of crime and poverty."

"The only remedy I can suggest is, a repeal of the law which enables a beer-house to be opened everywhere, and in that way remove many of the temptations which in these days beset a poor man at every turn. In my opinion, the number of public-houses of one class and another are a curse to the country."

"I have no doubt that beer-shops and gin-shops are the principal causes of intemperance."

Testimony of Chief Constables and Superintendents of Police.

"I am of opinion that much good would be effected by the closing of all beer-shops."

"I say that the beer-houses should be closed altogether. They are great inducements to drunkenness."

"I think doing away with beer-houses would cause less drinking, and prevent most of the misery arising therefrom."

"The beer-houses are a frightful source of intemperance."

Testimony of Governors of Workhouses.

"Beer-houses are the seat of vice and intemperance."

"The abolition of beer-houses would be a boon to the country."

"It appears to me one great check to intemperance would be that of closing beer-houses."

"I consider the present beer-house system very bad."

"It appears to me one great check to intemperance would be that of closing beer-houses."

"The abolition of beer-houses would be a boon to the working-man."

And so the testimony runs on through many pages of the report, but which it cannot be necessary to transcribe here.

This experiment for promoting the cause of temperance in England by the establishment of beer-shops there, may furnish perhaps the best practical criterion by which to judge of the results of a similar enterprise here. But we are not upon this subject left to form our opinions entirely upon foreign testimony and experiment. To the question, Does the sale of ale and beer increase or diminish crime? I have the written answers of several classes of public officers whose

connection with the courts of this State gives them unusual opportunities of forming a correct judgment upon the subject of the above inquiry.

1. *Answers of District-Attorneys.*

"It tends to an increase, due largely to the fact that the beer business supports many low places of resort and covers the sale of spirituous liquors."

"To this question it is impossible to give any answer based on facts. It is impossible to separate the results of these liquors, from the results of stronger liquors in any way to give satisfactory conclusions."

"Decidedly to increase crime."

"I have not been long enough in office to answer this intelligently. I think it an open question."

"I answer that the 'exemption of malt liquors and cider' clearly does not tend to diminish crime. How much increase of crime may be due to it I am unable to say."

"In my district nearly all the towns refuse to permit the sale of ale, &c."

2. *Answers of City Marshals and Chiefs of Police.*

"It increases crime."

"Increase."

"It does not decrease it, as under the free-beer law, the doors for the sale of ale and beer are thrown wide open, their sale and consumption increased and the *sale of distilled liquors is in no way diminished.* That 'free beer' decreases drunkenness, may be logic but isn't fact."

"About the same—if anything on the increase."

"Increase."

3. *Answers of City Missionaries.*

In reply to the question "what is the effect of the beer clause?"

"Bad and only bad."

"The effect has been to increase rather than diminish the amount of drunkenness in my district."

"Free beer means free rum."

4. *Answers of Judicial Officers to the same question.*

"It has already produced an alarming increase (of drunkenness) in many places."

"The unrestricted sale of beer is a fruitful source of intemperance and crime."

"As the city of Haverhill and surrounding towns have voted not to allow the sale of beer, I am not aware of any perceptible effect in this vicinity."

"Decidedly bad, so far as my knowledge extends."

It may be remarked in passing, that the papers from which the foregoing extracts are taken, show that the judicial and

prosecuting officers of the Commonwealth, city marshals and chiefs of police, keepers of prisons and superintendents of almshouses, all concur in attributing a large proportion of the crime and poverty existing in the community, to the use of intoxicating liquors.

Does the use of wines and malt liquors, and cider, tend to create an appetite for stronger liquors?

Answers to this question have been received from a large number of physicians. Their answers are not uniformly the same, though a large majority answer the question in the affirmative. One who has had very great experience in the treatment and care of the intemperate, says :—

"As far as my observation goes, the use of ale, wine and other fermented liquors does stimulate the desire for stronger drinks. The very nature of the case proves this. The disease, drunkenness, alcoholism or whatever you please to call it, *is generally superinduced by fermented drinks. Primarily they lay the foundation for the disease, and stronger liquors are usually resorted to for the reason that the weaker drinks fail to meet the demand of the diseased organism,* and when once this disease is acquired, the miserable victim goes on from day to day, demanding more and more of the poison, until death or curative agents release him from his thraldom."

Another physician of great eminence and extensive practice says :—

"Alcohol taken into the system produces the same effect, whether it be pure alcohol, rum, whiskey, gin or brandy or if it be wine, malt liquor or cider. So far as the alcohol is concerned the effect is the same, but the effect upon the system is greatly modified by the amount contained in the drink and by the vehicle in which it is conveyed. In wines there is less of alcohol than in ardent spirits. Different wines contain a different amount of stimulant. Malt liquors and cider do also contain alcohol, but in comparatively small amounts, and it is combined with other ingredients which are nutritious in some degree, and this makes the effects of each of them somewhat specific in their character. The beer drinker carries his marks with him. And the cider drinker is readily recognized in our country. So far then as alcohol is taken it tends to create an appetite for stronger liquors."

Another physician of equal eminence answers the question quite differently. He affirms that,—

"The experience of nations who use wines, malt liquors and cider, does not, in my opinion, prove that these beverages create an appetite for stronger liquors, and on the contrary, I think the experience of our own country

(which has never had mild wines, and has never used as freely as the Germans do, ale or mild beer, so that the Americans as a rule have been compelled to use the stronger liquors), proves that a people without wines or ales is liable to have in the highest degree this craving for stronger liquors. For certainly our race is more drunken then any European or mild-wine-drinking race, wherever it may be found."

This view of the subject is somewhat weakened, when it is remembered, that in France, a wine-producing country, and where light wines have been a common beverage of the people, the use of absinthe and other stronger liquors has become so great that the physicians of that country, "after various academic discussions of the evils resulting therefrom, have felt called upon to solemnly warn the French nation against such use."

That is, the free use of light wines has not prevented the people of France indulging in the use of stronger and more injurious stimulants.

And this leads naturally to the consideration of some important evidence respecting the use of wine, in the vine-growing portions of our own country. I am well aware that the testimony of travellers and residents upon this subject is contradictory. Some letters published in the last report of this Board, expressed the opinion that the culture and use of wines in Ohio, and California "had contributed to the lessening of intemperance," in those great States of the near and remote West.

I have now before me letters presenting a very different view of this matter.

A distinguished clergyman formerly of New England, but who has resided many years in California, writing under date of April 22, 1872, says:—

"This is undoubtedly one of the more favorable countries in the world, in soil and climate, for the cultivation of the vine. We have an immense capital already invested in the business,—certainly not less than $30,000,000. Every year extends our vineyards, and adds to the number of gallons of wine and of brandy manufactured on this coast. Last year's vintage yielded about 6,000,000 gallons of wine, and there were manufactured over 200,000 gallons of grape brandy. The annual average increase in the business is not far from $2,000,000. It is more and more evident that the abundance and cheapness of our wines, as well as their quality, both pleasant and strong, increase fearfully the amount of intemperance in California. In our wine-growing districts, and these are everywhere, there are very few families who

do not use wine freely. Whole communities are saturated with wine, men and women, young and old. *Nor does the drinking stop with wine. Beginning with this comparatively pure product it graduates speedily into the use of brandy and whiskey, and the worst of adulterated liquors.*"

The editor of "The Pacific" writing from his office in San Francisco under date of April 15, 1872, says:—

"Lager-bier has been freely made and used in this State for many years,—is not limited by any means to the German population, and is consumed in large quantities in mining districts, grain districts, fruit districts and wine districts. Nothing displaces it; nor does it displace anything. We have never heard of it as a temperance drink. Lager drunkenness is too frequent for that. Our impression is that the lowest, slowest, most illiterate, most unimpressible, most unimprovable, if not most vicious population, outside of the great cities, is found in the oldest wine districts of this State; and that the use of the product of vineyards has been the most active cause of this condition of the population; that the increased production and consumption of wine, on this coast, in the more recent years has diminished the use of neither distilled liquors nor lager-bier, but rather increased the demand for both. We never hear of people who forsake liquors and beer for the sake of wine; but we hear of many who never used an intoxicant, till they learned to love wine, and then have abandoned wine for something more stimulating. In a word, we do not believe that wines reform anybody, and we do believe that they beguile many into drinking habits, and finally into drunkenness, who would never have drank a drop but for wine."

Enough has been shown it would seem to demonstrate that the beer-shop system has in this country, as it did in England, signally failed, so far as it was expected to promote temperance or diminish intemperance and its attendant evils.

And it will be difficult to maintain the consistency or wisdom of the legislation, which does not include under the same prohibition, the sale of fermented and other intoxicating liquors. Especially would this seem to be true as a practical question in this Commonwealth, where upon the highest authority we are assured that nine-tenths of all the beer-shops have degenerated into mere grog-shops and tippling-houses; which, by the confession of every citizen who cares for the public welfare, are an intolerable pest and nuisance. And it is precisely on this ground,—because the traffic in intoxicating liquors as beverages becomes a common nuisance, producing great public evils,—crime, pauperism, public disorder and insecurity,—and resulting in consequent burdensome taxation, that the right and duty of the legislature arise to interfere by

regulative or prohibitory statutes. It is not upon the ground that the legislature has the right to interfere with the personal habits or private business of the citizen, except and only when these result in the production of the public evils above enumerated.

This brief statement will be closed by a reference to a few facts in the history of Sweden, illustrative of the beneficial effects of prohibitory laws, upon the production and sale of intoxicating liquors. These facts are taken from a manuscript letter, addressed to the Chairman of this Board from O. Carlhiem Gyllenskiöld, Chief of the Statistical Office in the Department of Justice. The letter was forwarded to the State Department at Washington, by Mr. Andrews, United States Minister at Stockholm, and from the State Department was sent to the Chairman of this Board. The letter may therefore be regarded as of the highest authenticity, and its statements entitled to full credit. Sweden is somewhat isolated in position, and her internal or domestic policy less liable to be affected by foreign influences than that of most European countries. The force and effect of her own legislation and domestic policy, can therefore be the more surely determined.

I proceed to quote from the letter :—

"In the time of our heathen ancestors, *ale* and *mead* appear to have been the only liquors of an exhilarating nature, commonly used in their houses. After the introduction of Christianity and the promulgation of the Roman Catholic faith, from the year A.D. 830, *wine* became more generally known and used; with the decline of the Church declined also the morals, and drunkenness became not an uncommon occurrence in all grades of society. In the latter half of the 15th century *distilled spirit* first became known in this country. and the use of it as a beverage, gave the Regent occasion, so early as 1494, to issue a prohibition against it."

The stages by which this result was reached should be noted: first, *ale* and *mead* were the only drinks; second, *wine*, leading to drunkenness; third, *distilled spirit*, producing such a state of things, as to call for the prohibitory Act of the government. If the use of ale and beer will cure or prevent the appetite for stronger drinks, why did it not have that effect among the Swedes?

But to resume our quotations :—

"These prohibitions were afterwards several times (1525–1840) proclaimed by the great social reformer, establisher of the Reform Church in Sweden, *Gustavus Vasa*.

"His son and successor, King John III. again permitted distillation, after which it was not long before the abuse of it as a drink spread. *Gustavus Adolphus* was consequently induced again to prohibit the sale of ardent spirits, but as this prohibition was repealed after his death, the distillation and consumption of spirits in certain districts, took such overwhelming proportions during the reign of Charles XI. (1660–1697), that even he was induced to take energetic measures to confine it within bounds. His son, Charles XII., who himself, from the commencement of his reign in his 17th year, never consumed any other fluids than water and milk, prohibited and maintained with vigor the prohibition against the distillation and sale of ardent spirits. During his wars abroad, the home government suspended the prohibitory ordinance. But upon the return of the king in 1715, one of his first cares was to counteract the pernicious consequences arising from the general liberty allowed for distillation. But hardly had the murdering bullet in the trench at Frederickshald, the 30th of November 1718, put an end to the king's life, before distillation was again rendered free, after which for more than 130 years, with few and short exceptions, spirits flowed, sometimes as it were inundating the country and causing the most terrible ravages. A vigorously maintained prohibition against spirits in 1753–1756, and again in 1772–1775 proved the enormous benefits effected in moral, economical and other effects by abstinence from spirits."

And thus the nation rose and fell, grew prosperous and happy, or miserable and degraded, as its rulers and law-makers restrained or permitted the manufacture and sale of that which, all along the track of its history, has seemed to be the nation's greatest curse. But there is not space here further to trace this very instructive branch of the history of one of the most remarkable nations of Europe, illustrating as it does nearly every phase of the "Liquor Question" which has arisen in this country, or is likely to arise, and the careful study of which could hardly fail to furnish our legislators and statesmen with invaluable information to guide them in dealing with a subject second in importance to no other within the range of American legislation.

REPORT

ON THE

CHARACTER OF SUBSTANCES USED

FOR

FLAVORING ARTICLES OF FOOD AND DRINK.

By HENRY K. OLIVER, M. D.

CHARACTER OF SUBSTANCES USED FOR FLAVORING ARTICLES OF FOOD AND DRINK.

In the spring of the present year, rumors of cases of illness, occurring some months previously in a family in Boston, and caused, as was supposed, by eating ice-cream of a certain flavor, came to the ears of the writer of this Report, and were communicated by him to the Secretary of the State Board of Health. This led to the suggestion, that the character of the substances employed for flavoring articles of food and drink receive investigation. Inquiry into the cases of illness alluded to was first made, and it was found that diarrhœa and vomiting had occurred in four or five individuals soon after partaking of a lunch of *pistache* ice-cream and other articles of a simple character, and that it was the firm impression of those affected that the ice was the offending substance.

Application was made by the writer to the manufacturer of the ice, a well known and widely patronized confectioner in Boston, who stated that the essential oil of bitter almonds had been employed to heighten the flavor of the cream. He added that, very probably, too much of the oil had been accidentally used. The oil had been obtained of a druggist in New York, and it was subsequently learned from him that it was of the manufacture of Allen, an English druggist, who is the distiller of the greater portion of the oil of bitter almonds imported into this country. The article of his manufacture is reputed to be of excellent quality, but this essential oil always contains hydrocyanic (prussic) acid, unless special processes for its removal are employed. This, however, is so rarely done, that it is safe to infer that the commercial oil has not been deprived of its poisonous element. That there might not be any doubt upon this point as regards Allen's

oil, a specimen was subjected to analysis, with the result of finding the presence of prussic acid.*

In this investigation of the character of flavoring substances, many articles in common use, such as the spices, have been eliminated, although deleterious substances are undoubtedly largely used in their adulteration. With this elimination, the list of substances possessed of sapid principles in common use is still pretty large. It includes the fruits, strawberry, raspberry, peach, pear, cherry, quince, currant, grape, lemon, orange and pine-apple. In addition, there are the winter-green, yielding the so-called checkerberry flavor, the sassafras, the peppermint, the bitter almond, the vanilla-bean and the rose.

Except to persons of peculiar idiosyncrasy, the fruits, etc., mentioned above are harmless, and perhaps to only one of them are individuals at all susceptible, namely, the strawberry, which some persons cannot eat without experiencing disagreeable symptoms. Of the other articles named, the winter-green, the sassafras, and the peel of the lemon and the orange, yield essential oils by distillation, which, like all essential oils, will produce irritation of the stomach and symptoms of intoxication when taken in large quantities and undiluted, but which contain no active poisonous element, as does the essential oil of bitter almonds. It ought to be mentioned, however, that the oil of lemon may, by exposure to the air, and perhaps to the light alone, undergo a change into oil of turpentine, but this change is of course readily detected.

It has long been desired to increase the list of the fruit flavors, and a resemblance to the taste of fruits not readily preserved, or not to be procured in sufficient quantity, has been obtained by the union of two or more flavors. The flavors of pine-apple and raspberry mixed, give a resemblance to strawberry; those of orange and almond, the nectarine. But, about twenty or twenty-five years ago, it was discovered that certain compound ethers possessed the odor and the flavor of many flowers and fruits, and a disposition was soon

* The analyses referred to in this Report have been made by Mr. H. B. Hill, Assistant in Chemistry in Harvard University, who has conducted for the Board of Health the investigations into the character of the adulterations of food.

manifested to take advantage of this circumstance. The list of flavors could then be greatly enlarged; perishable and rare fruits could be cheaply imitated in flavor by substances unchangeable and always at hand, and most persons would fail to detect the imposition. It is said to have been the opinion of some chemists, that the odors and flavors of flowers and fruits are really due to the presence of these ethers, and it is probable that this circumstance has greatly encouraged their employment.

It will be one of the objects of this Report to determine, not only the character of these factitious flavors, but also to what extent, and in what articles, they are employed.

In addition to those mentioned, other substances are employed in flavoring as substitutes for the genuine. Tartaric acid is often used, instead of lemon or its acid (citric), in the manufacture of lemon-sirup, and is also used to give tartness to jellies and to fruit-pastry, when the former are made of other fruits or other substances than they pretend to be, and when the latter contains no fruit at all. These facts will be made apparent in several stages of this Report.

The question of the substitution of nitro-benzole for the oil of bitter almonds will be briefly touched upon, in connection with the consideration of the latter article, which will hold prominent place.

A bare allusion will be made to some flavoring substances of a harmless nature, and the question of the use of strychnine in ales will receive brief notice.

Finally, the change from an innocent to a noxious substance, which sometimes takes place in the alcoholic extract of the vanilla-pod, seems to come appropriately into a report of this character; as does, perhaps, the large adulteration of this bean by the tonka-bean.

Essential Oil of Bitter Almonds.

The subject of the essential oil of bitter almonds claims first attention. This is obtained from the kernels of the fruit of *Amygdalis communis*, variety *amara*.

Christison, in his work *On Poisons*, says:—

"In small doses, the bitter almond produces disorder of the digestive organs, nausea, vomiting, and sometimes diarrhœa. These symptoms are

occasionally brought on by the small quantities used for flavoring sweetmeats, particularly when the confectioner has not been careful in compounding them. Virey says that accidents occasionally happen among children at Paris from their eating freely of maccaroons, which are sometimes too strongly flavored with the bitter almond."

According to Professor A. T. Taylor (Medical Jurisprudence), the almonds, when eaten in large quantity, have, on one or two occasions, "led to fatal symptoms and death."

When bitter almonds are expressed, they yield a bland fixed oil: and the residuary cake, reduced to powder by grinding, and submitted to distillation with water, gives over a volatile oleaginous product, commonly called oil of bitter almonds. It has a yellowish color, a bitter, acrid, burning taste, and the odor of the kernels in a high degree. Besides a peculiar volatile oil, it contains also hydrocyanic (prussic) acid, and its operation upon the system is closely analogous to this acid. The amount of acid which the oil contains is quite variable.*

Christison says :—

"The essential oil is not much inferior in activity to the pure hydrocyanic acid."

Pereira says :—

"Two drachms [about two teaspoonfuls] of it are said to have destroyed life in ten minutes. The amount of acid in it, and consequently its strength, varies very much."

Stillé (*Therapeutics*) says :—

"The volatile oil of bitter almonds is one of the most powerful of poisons. According to Dr. Taylor, one hundred parts of the oil contain nearly thirteen parts of anhydrous prussic acid. One drop of it is sufficient to kill a cat. This was shown by the experiments of Sir B. Brodie, who also illustrated in his own person its subtle power. Dipping the blunt end of a probe into the essential oil, he applied it to his tongue, meaning to taste the oil, for he had no suspicion that so small a quantity of it could produce any of its specific effects on the nervous system; but scarcely had the instrument touched his tongue when he experienced a very remarkable and unpleasant sensation, which he referred chiefly to the epigastric region. At the same time there was a weakness in the limbs, as if he had not command of his muscles, and he thought that he was about to fall. The sensations were, however, momentary."

* In regard to this point, Pereira may be quoted. He says (Therapeutics), "The crude oil is highly poisonous on account of the hydrocyanic acid which it contains, the proportion of which appears to vary from 8 to 10, or even in some instances to 14 per cent. Göppert obtained as much as 14.33 per cent. in one instance."

Then follow well authenticated cases of poisoning by the oil, which is not worth while to transcribe here, inasmuch as what has already been stated must be sufficient to prove its dangerous character.

With regard to the safety of the oil diluted, as when it is dissolved in alcohol, forming the so-called Essence or Extract of Almond, and Almond Flavor, Pereira says :—

> "These names are applied to an alcoholic solution of oil of bitter almonds, which is used by cooks for imparting the flavor of bitter almonds. It is sometimes prepared with the crude oil, and is then a dangerous poison, on account of the hydrocyanic acid which it contains."

In the discussion on the safety of diluting the oil, in Vol. XIII. of the Transactions of the London Pharmaceutical Society, Mr. Edwards, of Liverpool, said that "diluting the oil was not wholly enough; the danger of its use could only be entirely obviated by purifying the oil from prussic acid."

Mr. Nomady thought that the essence was more dangerous than the oil, from its being more palatable, and therefore more likely to be drunk. A case had come under his observation in which a servant, finding a bottle of the essence, which he mistook for noyeau, was instantly killed from tasting it.

A druggist swallowed, by mistake, half an ounce of "Almond Flavor." In half a minute he fell down in a state of syncope; his face being deadly pale, and his pulse imperceptible. Delirium followed, but he slowly recovered from the effects of the poison.

The last paragraph is copied from Taylor's Jurisprudence, where he comments upon the case, as follows :—

> "I cannot help remarking, that we have another instance of the disgraceful state of medical police in this country, in the fact that a deadly poison like this is allowed to be sold by druggists for the purpose of giving flavor to pastry and liquors."

As regards this country, the same use of a substance containing an active poison undoubtedly prevails, which prevails in other countries. As regards Massachusetts, it has been determined by direct inquiry, that the unpurified essential oil of bitter almonds, and the extract or essence of the same,

are used by confectioners and other purveyors in Boston, and that the latter form of the article is used to a considerable extent in domestic cookery all over the State.

Very little essential oil of bitter almonds is made in this country for the market, and none at all in Boston. It is nearly all imported, and that which arrives at this port is of Allen's manufacture, which, as has been stated, is found to contain prussic acid. The confectioners generally employ the oil itself. The extract, for domestic use, is prepared for this market by a single firm for the most part. They admit that they use Allen's oil. Their sales are undoubtedly very large, and they assert that no rumors of any deleterious effects from the use of the extract have ever come to their ears. It is believed by them that the alcoholic extract is much safer than the oil on account of its considerable dilution, and that inasmuch as the solvent, alcohol, is of marked pungency, a still greater safeguard is provided. But it has been shown that cases have occurred in which the extract has been drunk under the impression that it was flavored simply with peach-kernels, and that very dangerous symptoms have followed.*

In visits made to confectioners in Boston, it was found that the oil is employed by them whenever peach or almond flavor is desired. Of cakes, the so-called Bridecake is, perhaps, the only kind in which it is used. None of the parties visited seemed to have any fear that harm could follow its use. The almost universal answer was, that so little of it was required to flavor any article, that there could be no possible danger of using it in excess. "One or two drops," it was several times said, "would flavor a large quantity of anything." But this very power of the oil would seem to be the source of danger. If one or two drops go so very far, an additional drop or two must bring the article to which the oil is added near the point of danger. Now, it is notorious that cooks rarely measure the spices, etc., with which they flavor the articles they are preparing. They flavor "by guess," and the habit of confec-

* To make it quite certain that the almond extract of the firm alluded to contains prussic acid, an analysis was made. The quantity examined was the contents of one of the vials in which the extract is usually sold, amounting to two ounces. In this, something more than five-sixths of a grain of anhydrous prussic acid was found. This amount is only a little less than that which, according to Professor Taylor, would commonly suffice to destroy the life of an adult.

tioners is probably the same. And even if carefully "dropped," the risk is not done away with, for, as has been shown, the amount of acid which the oil contains is very variable. But without discussing this point further, it will be sufficient to refer again to the cases of illness which instituted the inquiries of this Report. Here is an admitted instance of too much oil of bitter almonds in ice-cream, followed by annoying, if not dangerous, symptoms, in the individuals partaking of the flavored article.

The question next presents itself, whether there is not some other substance which yields the highly prized almond flavor, and which does not contain any poisonous element. Nitrobenzole has been mentioned as a substitute, but this is of itself, as will be seen in a subsequent part of this paper, a dangerous poison. But cannot the oil of bitter almonds be deprived of its prussic acid and yet retain its peculiar odor and flavor? This is a question which the writer put to himself while making his investigations, but to which he was unable, at the moment, to give an answer. Upon seeking information of others he found that almost every one who dealt in, or used, the oil, was of the opinion that the presence of prussic acid was necessary to the existence of the odor and flavor. The most intelligent druggists agreed with the least informed confectioners on this point, while some of the former were of the opinion that, even if the acid were withdrawn, the oil would still be poisonous even in small doses. A letter from the proprietor of an extensive and reputable druggist's establishment in New York, who was asked if he could furnish the oil of bitter almonds free from prussic acid, contained the following decided language: "There is no oil free from acid. There never was and there never will be. It would have neither taste nor smell." A very different opinion, it was found, was held by chemists who were consulted, and subsequent search in scientific works and journals placed the matter beyond a doubt.

In a lecture delivered in the establishment of the Pharmaceutical Society of London, by Mr. R. H. Semple, on Vegetable Poisons, and which is published in the Transactions of the Society, April 5th, 1854,* the following occurs:—

* Vol. II., p. 29.

"Hydrocyanic acid exists in some plants which are poisonous in consequence of its presence. * * * * The poison procured from them exists in two forms,—as distilled water and as essential oil. Both contain prussic acid. They have a powerful, peculiar and grateful odor, which is usually likened to that of pure prussic acid, but the smell really bears little resemblance to prussic acid, and is not owing to its presence. * * * * The oil is hardly inferior in activity to prussic acid. * * * * But if this oil be entirely freed from the acid, it is not more poisonous than other essential oils, though it still retains its characteristic and grateful flavor. As the oil of bitter almonds is very extensively employed in flavoring articles of confectionery, a German writer suggests the propriety of removing the prussic acid from the oil by repeated distillation with caustic potash, which removes the poisonous ingredient, but does not at all injure its other properties."

In Wood's *Therapeutics*, Vol. II., p. 184, may be read :—

"The oil of bitter almonds consists mainly of hydrocyanic acid dissolved in or combined with a volatile oil, upon which its peculiar odor and taste chiefly depend. When freed from the former ingredient, it has the ordinary properties of the volatile oils, and retains its smell and taste, but is no longer poisonous."

Dr. Hassall, in *Adulterations Detected*, says :—

"There is another compound of prussic acid, called 'Almond Flavor'; it contains about one drachm of the essential oil to seven drachms of spirit, but its strength varies very much. Many fatal cases have resulted from the use of this flavoring substance. The prussic acid in these preparations is not essential to their flavor, and might with a little care be readily separated, so that, as Professor Taylor remarks, in his evidence before the Parliamentary Committee on Adulterations, 'There is no excuse for selling prussic acid in these compounds but laziness and ignorance.'"

In the "London Lancet" of June 21, 1856, is the following article under the heading, "Essential Oil of Bitter Almonds freed from Prussic Acid" :—

"The possibility of depriving the essential oil of bitter almonds of the hydrocyanic acid with which it is united in the raw state has long been known, yet this oil, so extensively used by confectioners and others to flavor pastry and similar articles, is still, for the most part, sold contaminated with prussic acid, which adds no advantage in point of odor, and at the same time renders the essence highly dangerous in inexperienced hands."

The article then acknowledges the receipt of a specimen of oil of bitter almonds from Mr. Langdale, a London druggist, which on examination was found to be quite free from prussic acid.

Many other authorities might be quoted to prove that the purified oil possesses the odor of the original oil, among them Göppert, of Breslau, Robiquet, and Boutron-Charlard, Stange and B. Silliman.

But it is even asserted that the flavor of the oil is improved by removing the prussic acid. Mr. W. Price Jones, resident medical officer of University College Hospital of London, in the summing up of the results of some experiments with oil of almonds, which will be presently transcribed from the "London Lancet," says :—

"Besides the invaluable advantage of having the hyduret of benzole (purified oil of bitter almonds) pure, the flavor is far more delicate than that which is commonly sold in the shops as the essential oil of almonds, it being free from the metal-like, bitter taste which is imparted to the latter by the hydrocyanic acid."

What has been said proves that the oil of bitter almonds can be deprived of its prussic acid and yet retain its peculiar taste and smell. It remains to show that the oil thus purified is innocuous, or as much so as other essential oils, all of which are capable, as has been stated, of producing disturbances of the system when taken in certain quantities.

In the "London Lancet" of January 10, 1857, is an article under the caption *Poisoning by Essential Oil of Bitter Almonds—Experiments on Animals*, as follows :—

"The numerous deaths, suicidal and otherwise, that have occurred from the use of the commercial oil of bitter almonds, which is contaminated usually with a considerable amount of prussic acid, have imperatively called for an earnest demand that the legislature should interfere to check the sale of the article in question, unless it be divested of its deleterious ingredient. This is readily effected; several manufacturers actually purify the essential oil of bitter almonds so far as to render it perfectly innocuous, and thus improved it may be obtained in shops as well as the ordinary and injurious article. It is indeed found stated in some old treatises on *materia medica* that the essential oil of bitter almonds (or hyduret of benzole), thus purified, is itself poisonous; and the statement was repeated by a writer in the 'Times' of November 24, last. In order to ascertain the truth by a personal examination, some scientific gentlemen were commissioned by the editor of the 'Lancet' to conduct and witness certain experiments on animals at the establishment of Mr. Langdale of 72 Hatton-Garden, who was one of the first manufacturers of the purified essential oil of bitter almonds. In the presence, therefore, of several gentlemen, some investigations were entered upon by the commission on Wednesday, November last, with results which we proceed to describe. The animals experimented upon were a dog, a cat

and four rats. The greatest care was taken to insure perfect accuracy in the mode of performing the experiments and in the observations made.

"Experiment 1 was with the dog—a young, short-limbed, and strong shepherd's dog. A drachm of Mr. Langdale's *purified* essential oil of almonds was poured down his throat. The animal soon showed symptoms like those of intoxication with ardent spirits, but in a quarter of an hour was able to walk about as usual.

"Experiment 2.—A lively rat was taken out of a cage and held, with mouth open, by a professional rat-catcher, whilst four drops of Langdale's purified oil were dropped from a glass measure into the mouth. This dose appeared to have a very trifling effect; the animal manifested little diminution of activity, did not fall nor show any signs of convulsion. In a few minutes it was put back again into its cage, and long before the termination of the remaining experiments, no persons could have detected from its behavior that it had been itself the subject of one.

"Experiment 3.—A rat, similar in size and activity to the foregoing, was taken out and held in the same manner, when four drops of the ordinary commercial essential oil of almonds were dropped into the mouth from a half-ounce bottle full of that fluid. The animal immediately afterwards manifested convulsive motions, speedily the breathing became laborious, and the rat fell on its side, in which position it continued to lie, frequently subject to violent spasms, until it died in about six minutes and a half after the administration of the poison.

"In experiment 4, a larger rat, to which also four drops of the unpurified oil, but containing less prussic acid, were given, died in fifteen minutes.

"In experiment 6, half a drachm of Langdale's purified oil was given to a cat of moderate size. The effect was much the same as with the dog, and the animal, in four minutes from the administration of the oil, had to all appearances wholly recovered.

"The instances above cited have proved the following facts:—that of Langdale's purified essential oil of almonds, one drachm administered to a middle-sized dog, half a drachm to a cat, and four drops to a rat, were incapable of destroying life, while four drops of the ordinary essential oil of almonds killed a rat in two instances. * * * * Although not fatal in its effects, the purified essential oil of bitter almonds, like other essential oils, cannot be swallowed in its undiluted state with perfect impunity to the digestive organs, any more than alcohol or cayenne pepper. No doubt, in doses of a drachm, or half a drachm, it is calculated to produce an inflammatory condition of the mucus lining of the alimentary canal. It is highly pungent, and a drop placed on the tongue produces a sensation very analogous to that occasioned by tincture of iodine similarly applied; and it cannot be properly employed in confectionery except when diluted with alcohol, in which it is perfectly soluble. Other essential oils, in large doses, have proved fatal to animal life from their stimulant effect."

In proof of this latter statement some experiments by Mr. W. Price Jones are given, and the results are thus summed up by him:—

"From the results of these experiments I conclude that, notwithstanding a large quantity given to a small animal, proved, in one instance fatal, the *purified* oil of almonds cannot be regarded as a poisonous substance, and that

it is at least as harmless as oil of caraway, which may be fatal when given in an inordinate dose."

No well-grounded objection can probably be made to the purified oil or to its alcoholic solution. Some fear has indeed been expressed that both forms would, after a time, lose their flavor by being oxidized, the result being the formation of benzoic acid; but Messrs. Preston and Sons, in a note to the editor of the "Pharmaceutical Transactions" (Vol. VI., p. 435), assert that they have kept specimens of each exposed to the light and air for a long time, without any change whatever taking place in them.

After what has been said, the natural question arises, if legislation ought not to interfere to forbid the indiscriminate use of so powerful a substance as the unpurified oil of bitter almonds. It has been more or less prescribed by physicians on account of the prussic acid it contains, which has valuable medicinal qualities, but even physicians now rarely use it, because the amount of acid which the oil contains is so variable: they prefer to use the acid itself, in the officinal diluted form, the strength of which is known. Pereira says: "In this country" (England) "essential oil of bitter almonds is not employed in medicine."

Calls for legislation concerning this oil have long been made in England. In a leading article in the London "Lancet" of June 21, 1856, occurs the following:—

"The agreeable qualities of this liquid render it peculiarly dangerous, and it is therefore an article which ought by every means to be prevented from reaching the hands of those not fully acquainted with its noxious properties when administered in excess. It does not augment the enjoyment of a festive occasion to know that the custards, pound-cakes or sweetmeats set before us may carry with them death or danger. * * * * When it has been proved incontestably that science is capable of securing all the desirable qualities of a substance, free from the admixture of a chemical compound of a most dangerous and powerful kind, there ought surely to be a prohibition against the sale of the article which is not deprived of the deleterious admixture."

In an article of similar tenor in the issue of January 10, 1857, the same journal gives an idea of the amount of oil used for flavoring purposes annually in England:—

"It is estimated that about eight thousands pounds of the ordinary essen-

tial oil of almonds are manufactured and delivered for the retail British trade annually. Since the introduction of the cheaper nitro-benzole into the manufacture of perfumes, the whole of the above large quantity is destined to be eaten or drunk in some shape."

No attempt has been made to determine the amount of the oil used in this country, but there arrived at the port of Boston during the year 1871 one hundred and forty-nine pounds, equal to about the same number of pints. This is rather below than above the average yearly importation. Of these one hundred and forty-nine pounds or pints, forty-nine pounds were consigned to three of the wholesale druggists of Boston, and by far the greater portion of this amount was, or will be, used for flavoring purposes, either as the oil itself or as the alcoholic extract.* Of the oil of bitter almonds less than a teaspoonful has destroyed the life of an adult. Two teaspoonfuls will, in the majority of cases, prove fatal. We have therefore in the forty-nine pints of oil, about 2,750 fatal doses.

It may not be out of place to state what became of the additional one hundred pints of oil, containing 5,500 fatal doses. This quantity was consigned to a manufacturer of a patent medicine.

Nitro-Benzole, or Oil of Mirbane.

Nitro-benzole, or oil of mirbane, is the result of the action of nitric acid on benzole, which is one of the lighter products of the distillation of coal-tar. It is characterized by having an odor closely resembling that of the oil of bitter almonds, and it has, therefore, sometimes been called the artificial oil of bitter almonds. It is principally used in the manufacture of aniline colors and for scenting soap and perfumery. It is also said to be used to some extent by confectioners, on account of its cheapness, compared with the oil of bitter almonds. Although it is not, like the latter substance, contaminated with prussic acid, it is nevertheless a very active agent, and cases of death are on record after swallowing a very

* This statement is given on the authority of druggists. In answer to a question as to the probable destination of the oil sold by them, one said, "Probably not over a pound of it was used in medicine." And another, "Very little indeed of it went into prescriptions."

few—eight or nine—drops of it. Moreover, it is very dangerous when its vapor is inhaled for any length of time. Several deaths have occurred from this cause, one case being in Boston.*

With regard to the use of nitro-benzole for flavoring purposes in this city and State, it is not believed that a great deal is so employed. At all events, none of the confectioners visited by the writer admit using it, and none has been met with on sale at grocers or druggists. The opinion of one of the proprietors of the largest manufacturing coal-oil establishment in Boston, where nitro-benzole is made to some extent, is that this substance is very little employed for flavoring purposes by purveyors to the public, in this city at least. Neither does he know of its being sold for this purpose here. On the other hand, a well-known manufacturing chemist asserts, in a letter to the writer, received late in the preparation of this Report, that nitro-benzole "has been to a considerable extent substituted for the essence of bitter almonds, in the manufacture of sirups, cake, candies, &c. It has a regular sale, but how extensive it is I cannot state positively." It is possible that further search in obscure localities in this city, and in the country, may reveal its employment, as a flavoring substance, to some extent.

The Artificial Fruit Essences.

The compound ethers which have been found to possess the odor and flavor of certain fruits, are several in number.

Butyric Ether.—This ether may be prepared by mixing butyric acid with sulphuric acid (oil of vitriol) and alcohol. The former acid may be made by mixing decaying cheese with grape-sugar and chalk and allowing fermentation to take place. The ether is dissolved in another portion of alcohol and forms the pine-apple essence.

Pelargonic Ether, *Œnanthic Ether*, may be prepared by digesting pelargonic acid with alcohol at a gentle heat. The acid is the result of the action of nitric acid (aqua-fortis) on oil of rue. The ether is dissolved in alcohol and forms the quince essence.

* Boston Medical and Surgical Journal, January 18, 1872.

Acetate of Amylic Ether is prepared by distilling a mixture of fusel oil, acetate of potash and concentrated sulphuric acid. An alcoholic solution of the ether forms the Jargonelle pear essence.

Valerinate of Amylic Ether may be made by the action of sulphuric acid and valerianic acid upon fusel oil. An alcoholic solution of this ether forms the apple essence.

A mixture of acetate of amylic ether with butyric ether forms the banana essence.

Other mixtures of the ethers, modified by the addition of various agents, as nitrous ether, acetic acid, camphor, tincture of orris, vanilla, the volatile oils, &c., result in imitations of other fruits, the strawberry, raspberry, apricot, currant, &c., &c.

Are these artificial fruit essences deleterious to health? A succinct answer to this question cannot properly be given. If taken into the stomach in any considerable quantity, and in an undiluted form, the effect would, without doubt, be not simply deleterious but highly dangerous. But, in the form in which they are presented in confectionery, &c., they are more or less diluted; the chance, therefore, of harm following their occasional use is greatly lessened. But even when diluted, habitual indulgence in them, according to the opinion of scientific men, cannot fail to be injurious to health. And deleterious results may follow their occasional use, even when in the diluted form; this may happen in the case of adults, on account of a peculiar idiosyncrasy. And in all cases, probably, children are more susceptible to their influence than adults. Children are also more likely than adults to partake largely of confectionery, and a free indulgence in articles of this kind, in a season of the year when disorders of the intestinal canal are prevalent, has been known to bring on such disorders, or to aggravate them when existing. It is, however, sometimes the case that sufficient dilution of the flavoring ether has not been made, and alarming consequences have attended such carelessness. The writer was informed by a distinguished chemist and physician, that, within his personal knowledge, two children—one of them, indeed, his own child—were seized, after drinking the liquid contained in a hollow toy, candy-anchor, with alarming sedative symptoms, requir-

ing active medical treatment. Enough of this liquid was secured to prove that it was flavored with the artificial pine-apple essence.

When these essences first came into use, confectionery flavored with them was exceedingly popular; but it was not long before it became so evident that indulgence in such confectionery was attended with evil results, that caution was given in the newspapers of the day, and the sale of the "fruit-drops," &c., greatly diminished.

Dr. Hassell, in his *Adulterations Detected*, says: "Many articles of sugar-confectionery are flavored with 'essences' which are often of an injurious and even dangerous character, some of them containing prussic acid and fusel oil."

"I have heard," says Professor A. S. Taylor, "that some of the Jargonelle pear-drops and the ribstone pippin-drops have produced drowsiness and stupor in children. It is an imposition on the public to sell in this way a chemically flavored substance under another name."

As regards the use of these artificial fruit essences, it is an undoubted fact that they are very extensively employed everywhere, for flavoring jellies, confectionery of various kinds, and sirups for soda-water. They are also used in the manufacture of factitious wines and other alcoholic liquors. They are found to be less adapted to ices than to the other articles mentioned, and are probably used in them to a very limited extent, and not at all by confectioners of any repute.

The following are some of the results of inquiries at confectioners' establishments in Boston:—

F.—A confectioner in excellent repute; makes ices and cakes principally; some candies. Never uses the artificial essences. Has a limited number of flavors.

M.—Ditto; ices and cakes principally. No artificial essences. Flavors limited in number

W.—Ditto. Ditto. Ditto. Ditto.

C.—Ditto; ices, cake and candies. No artificial essences. Flavors limited in number.

C.—Ditto. Ditto. Ditto. Ditto.

P.—Cheap ices only. No artificial essences. Is enabled to sell cheaply on account of simplicity of materials used, and extensive sales.

S.—Large manufacturer of candies only. In good repute. Uses the artificial essences to some extent. Desires to have a good list of flavors, and finds it difficult to use fruit-juices in any but soft candy, on account of their

watery element. Does not know of harm resulting from the use of candy artificially flavored.

J.—Extensive manufacturer of popular candies, sold principally in the street and in places of public resort, railroad stations, etc. Uses the artificial essences exclusively, for fruit flavors. Manufactures the essences himself, from the best materials. They cost him nearly twice as much as those which he formerly bought, and which are used to a great extent by imitators of his candies. Thinks the cheap essences are bad, but has a very different opinion of those made by himself. "If a child, who was about to be ill, should eat candy of my manufacture, it might do harm, but so would a piece of cake eaten under such circumstances." Does not care about using the artificial flavors: would make more money to limit the flavors to the essential oils if he could sell the same amount of candy, because the oils are cheaper; but people like the taste of fruit flavors, and his sales are correspondingly increased.

In the perusal of the above, it will be perceived that the ices are uniformly pure, as far as the artificial essences are concerned. The list of fruit flavors was very limited. As regards candies, the list of flavors varied in extent, and whenever it included many of the fruits, artificial essences were invariably used. The compound ethers seem to produce an unpalatable change in some of the usual ingredients of ices, and they are, consequently, not much used therein. In candies, however, no similar change seems to take place, and as the juices of such fruits as the strawberry, raspberry, pear, banana, etc., etc., are not easily manipulated in sugar, and must, moreover, be preserved, to be used out of season, at considerable expense, the artificial essences have, for the most part, taken their place. Almost all the candy in the market, therefore, bearing the flavor of the easily perishable fruits, is prepared with the artificial fruit essences.

The extent to which the compound ethers are employed in the sirups which are used with soda-water, so called,* will appear from records of visits made to druggists and apothecaries. To avoid repetition, mention will also be made here of the method of flavoring lemon and sarsaparilla sirups.

M.—Druggist and apothecary in excellent repute; does not use the artificial essences. List of flavored sirups limited to raspberry, pine-apple ginger, lemon and sarsaparilla. Makes the first two of fruit, and of sufficiently heavy body to keep well. The lemon sirup is difficult to keep;

* "Soda-water" is simply water charged with carbonic acid gas.

uses therefore citric acid and oil of lemon. Sarsaparilla, of itself, has little flavor; adds therefore the oils of wintergreen and sassafras.

B.—In good repute; has coffee, raspberry, strawberry, pine-apple, lemon and sarsaparilla sirups. The raspberry and pine-apple are made from the fruit. The strawberry is made by adding the essence of strawberry to the raspberry sirup. Lemon, made of citric acid without addition of oil of lemon. Sarsaparilla, flavored with oils of wintergreen and sassafras.

B.—Ditto; has a good list of flavors, as to number, and in all cases from the fruit kept hermetically sealed. Lemon is of citric acid and oil of lemon. Sarsaparilla, made as by the two preceding druggists.

L.—Ditto; a good list; all fruit. Strawberry of equal parts raspberry and pine-apple. Lemon and sarsaparilla as before.

C.—In fair repute; a pretty good list. Pine-apple from the fruit. Raspberry bought in sirup, heavily flavored and probably artificial. Strawberry, a mixture of raspberry and pine-apple. Lemon, of citric acid and oil of lemon. Sarsaparilla, of molasses and water flavored with the oils already mentioned.

A.—In quite moderate repute; a pretty good list; all fruit. Sarsaparilla as before. Lemon, of tartaric acid and oil of lemon.

J.—In little repute as an apothecary; deals mostly in perfumery and toilet articles. Record much as J's. except citric acid in the lemon sirup.

K.—Repute as preceding; makes a specialty of dispensing "cream-soda." A very large list of flavors. Uses the artificial flavors exclusively. Cannot use fruit because their acids curdle the milk and injure the appearance of the beverage. Customers cannot distinguish the artificial from the true fruit flavors.

In addition to the druggists and apothecaries mentioned, two other establishments were visited; one where the soda-water fountains are charged with their contents, and where sirups are made, and another where the apparatus for dispensing the soda-water is extensively manufactured, and where sirups are also prepared. At the first named, sirups are made principally for the country, and for street stands, railroad stations, and other public places in the city. The only sirup made from the fruit is pine-apple. The other fruit flavors are made from the artificial essences. Lemon is made of tartaric acid and oil of lemon.

At the second establishment the sirups are of both kinds, from the fruit and artificially flavored. The pure juice of fruits is also sold for mixing with simple sirup. The proprietor thinks that, as general thing, the real sirups give better satisfaction, although, for the most part, consumers cannot distinguish between the two. The pure sirups are pretty generally used in the city and those artificially flavored in the country.

Letters have also been received by the writer of this Report from establishments at a distance, in answer to inquiries concerning the use of the artificial sirups.

M.—Of New York, writes: "Imitation fruit sirups are commonly used, and, when properly made, are often preferred to pure fruit."

F.—Of New York, writes: "We send enclosed price list of our flavors, which are in *general* use. We have not got the real fruit sirups."

It will be noticed that, although the use of the artificial essences in soda-sirups is common enough, as a general thing the druggists and apothecaries do not use them to a great extent. Those of the best repute probably do not use them at all. They all agree in using citric or tartaric acid in place of lemon juice, on account of the difficulty of keeping pure lemon sirup for any length of time. Both citric and tartaric acids, however, are true fruit acids, the former coming from the juice of the lemon and the latter from cream of tartar, which is a deposit from wine. If used in the proper amount, neither of these acids can be deleterous in an occasional summer beverage. Except in one or two instances, the lemon sirup was still further approximated to the genuine article by the addition of oil of lemon.

Without exception the oils of winter-green and sassafras were added to the sarsaparilla sirup to supplement the flavorless preparation of that root. Oil of anise is said to be sometimes used in addition to the two oils mentioned. In one instance, there was no sarsaparilla whatever in the sirup bearing that name, which was simply molasses and water flavored as usual. Probably the greater part of the so-called sarsaparilla sirup dispensed with soda-water in obscure parts of the city, and at the smaller apothecaries everywhere, is quite innocent of the famous root. It is the "fountains" in just these localities that are visited by the class of persons, who periodically think that their blood is "out of order," and who select sarsaparilla sirup with the object of purifying it, drinking the beverage with the most undoubting faith in its virtues.

It may be mentioned that, where the essences are used in the sirups, a small portion of either citric or tartaric acid is used to give a slightly tart taste. Where, also, the sirup is

to represent the flavor of any of the red fruits, as the strawberry, for instance, coloring matter must be added. This is generally made of cochineal. The sarsaparilla sirup, also, generally receives a little coloring, except when molasses is used, and the coloring substance is caramel.

The following directions for making strawberry sirup are taken from the "Descriptive Catalogue" of an extensive manufacturer of soda-water apparatus. Many others are given :—

"*Strawberry Sirup*,—made without the fruit;—add to one gallon simple sirup, two teaspoonfuls of essence of strawberry and a quarter of an ounce of tartaric acid. Color with coloring made as follows: Boil one ounce of cochineal with half a teaspoonful of cream of tartar; strain."

Employment of the Artificial Essences in Fruit Jellies.

In one of the March, 1872, issues of the *Scientific American*, a correspondent inquired the method of manufacturing fruit jellies. Answers to this question appeared in subsequent issues of this journal. One of them, in the issue of April 6th, reads thus :—"Fruit jellies are simply gelatine dissolved in water, colored, and flavored with the so-called 'flavoring extracts.'" A second answer reads thus,—"Fruit jellies, so called, are made by putting half an ounce of alum in one pint of water; let it boil a minute, or till dissolved, then add four pounds white sugar; boil two minutes longer, and strain; when cool, add half a two-shilling bottle of vanilla, lemon, or strawberry extract, or other flavor."

Still a third answer, in the issue of April 27th, reads,—"Fruit jellies are made of sweet unfermented cider boiled in sugar to the consistency of jelly, flavored and colored to taste."

These directions, which differ from the processes employed by house-keepers, who are in the habit of using currants when they wish to make currant jelly, quinces when they desire quince jelly, etc., etc., suggested inquiry into the character of the fruit jellies made for sale in Boston.

It was learned from a confectioner of good repute, who makes jellies in small quantities, that currant jelly, for instance, cannot be sold, at a profit, for much less than fifty

cents per eight-ounce tumbler. It was also learned, from a manufacturer of jellies on a large scale, that when thus made, this jelly ought to sell at from forty to fifty cents. "We make," said he, "a jelly with a basis of apple jelly,—say two-thirds of the whole amount,—with the remainder of currant. This sells at a less price, but it is not called currant jelly, but "Pomona." It is of a much lighter color than currant, and has, of course, much less flavor."

It was inferred from these inquiries, that currant jelly, of deep color, which could be sold at less than forty cents per eight-ounce tumbler, must be made of something besides the pure fruit. A visit was next made to C Street, which contains a considerable number of grocer's establishments of the second-class, and at every one visited, some ten or twelve, currant jellies, of a deep color, were selling at from twenty to twenty-five cents per eight-ounce tumbler. In addition to this variety, jellies of many other fruits (or so labelled) were selling at the same price. The names and addresses of several of the manufacturers of these jellies were taken, and three of them were visited. The result of the interviews is here given :—

P.—Formerly kept jellies from the pure fruit, but found it didn't pay and now keeps none at all. Those now kept are made from apples, properly colored, and flavored with the artificial fruit essences bought in New York. Pays the highest prices for these essences. The jellies cannot be distinguished, by customers, from those made from pure fruit; the latter are really no better. They retail at from twenty to thirty cents per eight-ounce tumbler, according to the locality of the retailer. Keeps currant, raspberry, strawberry, blackberry, peach, quince, crab-apple, pine-apple and grape."

The currant jelly was tasted at this place. The taste decidedly resembled the currant flavor, so that it would generally pass for the genuine article; the substance of the jelly seemed, however, to lack firmness.

In an advertising circular issued by P's establishment, "the special attention of dealers, hotels, restaurants, and families is invited to the large and varied stock of preserves in bulk, stone pots, and glass, which for purity and richness of flavor are unequalled by any in the market."

R.—Makes his jellies of apple, flavored with the artificial essences, with two exceptions, viz.: crab-apple and grape; these are of pure fruit. Keeps

strawberry, raspberry, blackberry, cranberry, barberry, quince, peach, currant, apple, crab-apple, pine-apple and grape. They will retail at about twenty-five cents. Uses a little fruit (citric or tartaric) acid in some jellies. It is difficult to distinguish the artificial from the genuine unless "one has experience."

C.—Makes jellies from the fruit and also from apple artificially flavored. Consumers can't distinguish between the two. The artificial sells for twenty-five cents per tumbler. (The list at this establishment includes black currant and plum.)

It thus appears that large quantities of spurious jellies, artificially colored, and flavored with the artificial fruit essences, are made and sold in Boston. If it is, as Professor Taylor justly says, an imposition to employ these essences in confectionery, what term ought to be applied to their employment in fruit jellies which are so much used by sick persons? But it is, undoubtedly, a subject for congratulation that apple, and not glue, forms the basis of these jellies, and that alum does not probably enter into the manufacture, except so far, perhaps, as is necessary in the preparation of the coloring matter.

This coloring matter is generally the same substance as that used in soda-sirups, namely: cochineal, which, it may be stated is, of itself, harmless enough. In the circular of a prominent manufacturer of "Extracts for Cooking" in this city, may be read,—"Extract of Cochineal—For giving a fine red tint to jellies, etc."

Employment of the Artificial Essences in Alcoholic Liquors.

The artificial essences are employed, to a greater or less extent, in factitious wines and other alcoholic liquors, and are generally kept for sale, for this purpose, by what are known as Brewers' Druggists. This class of persons made its appearance years ago in Eur pe, and flourished especially in England. Hassall says of these druggists: "These persons issued regular price-currents, and they made it their business to send travellers all over the country, with lists and samples, exhibiting the price and quality of the articles manufactured by them." The substances sold for flavoring and giving strength to alcoholic liquors were, according to Hassall, cocculus indicus, grains of paradise, capsicum, ginger, quassia, wormwood, calamas root, caraway and coriander

seeds, orange powder, liquorice, honey, sulphuric acid, cream of tartar, alum, carbonate of potash, hartshorn shavings, nux vomica, gentian, chamomile, tobacco, opium, orris root, juniper berries, angelica root, and bitter almonds.

To this list modern chemistry has added many of the compound ethers.

While searching for materials for this Report, a circular fell into the writer's hands, the introduction of which was as follows :—

Important Information for Practical Men.—Eiehler's Receipts for Liquors, Sirups, Bitters, &c., will save hundreds of dollars, which you are now paying to others for preparing your Whiskeys, Brandies, Gins, &c. These receipts embrace the most concise, accurate and practical directions for the convenient preparation of the various beverages, in large and small quantities. But one receipt is given for each article, so that there is no need of expensive experimenting. The ingredients recommended for flavoring and coloring are all easily procurable, perfectly harmless and can be used with the utmost confidence. Special care has been taken to so arrange the receipts, that no expensive apparatus is necessary. In fact, the majority of all the formulæ may be prepared by simple mixing.

Liquors made according to these receipts so closely resemble the genuine that they often cannot be distinguished. They answer for all the same intents and purposes, as the flavors for preparing them are identical with those which are formed naturally during fermentation. Modern Chemistry, which has by analysis discovered the existence of these ethers in Wines and distilled Liquors, has also found other more abundant sources for them, rendering it highly advantageous to employ the latter.

Communication was established by the writer with the druggist who issued this book of receipts, and the work was obtained. A few of the receipts are here given.

Irish Whiskey.—Concentrated essence Irish whiskey, one-quarter pint; age and body preparation, one pound; pure rectified spirits, forty gallons.

To improve the above, add five gallons genuine Irish whiskey.

Improved Corn Whiskey.—Sweet spirits of nitre, two ounces; acetic ether, one ounce; age and body preparation, one pound; corn whiskey, forty gallons.

New York Whiskey.—Concentrated essence Bourbon, four ounces; compound tincture of green tea, one pint; tincture of capsicum, one pint; tincture of grains of paradise, one pint; corn whiskey, twenty gallons; water, twenty gallons.

New England Rum.—Concentrated essence New England rum, one-half pint; rectified spirits, or molasses whiskey, forty gallons.

Santa Cruz Rum.—Concentrated essence Jamaica rum, six ounces; concentrated extract vanilla, four ounces; brandy coloring, one pint; age and body preparation, one pound; rectified spirits, or molasses whiskey, forty gallons.

To improve the above, add a strained decoction of two pounds St. John's bread, two pounds raisins, one pound figs, in two gallons water.

Auction Brandy.—Brandy flavor, one-quarter pint; tincture of green tea, one pint; tincture of capsicum, one pint; tincture of grains of paradise, one pint; age and body preparation, one-half pound; rectified spirits, ten gallons; water, ten gallons; brandy coloring, sufficient.

French Brandy.—Brandy flavor, one-half pint; age and body preparation, one pound; brandy coloring, one pint; pure rectified spirits, forty gallons.

If wanted for immediate use, double the above proportions must be used. To improve the above, add about five pounds each of bruised raisins and St. John's bread to each barrel.

Port Wine.—For forty gallons. Port wine ether, four ounces; aromatic tincture, eight ounces; tincture of rhatany, eight ounces; tincture of orris, twelve ounces; simple sirup, three gallons; rectified spirits, three gallons; wine coloring, two gallons; plain or raisin wine or fermented cider, thirty-two gallons.

To improve the above, add five gallons imported port wine. Instead of the wine coloring, either elderberry, cherry or huckleberry juice can be used, wholly or in part.

Cheap Port is like the above, except that the orris is omitted, fruit acid added, the wine and cider omitted and replaced by water, and the spirits increased.

Madeira Wine is made of Madeira ether, tincture of rhatany, fruit acid, brandy color, simple sirup, rectified spirits and water.

London Sherry, of picked and crushed raisins, simple sirup, white argols, cider, soft water, rectified spirits, and fluid extract of wild cherry.

Imitation Champagne, of sugar, water, white argols, sweet cider, yeast: and when fermentation commences, add rectified spirits and tincture of orris.

Imitation of Claret, of fermented cider, rectified spirits, simple sirup, clear water, wine color, tincture of catechu, tincture of orris and fruit acid.

Hop Beer, of molasses or simple syrup, fluid extract of hops, water and yeast.

Leave the bung out for about twenty-four hours, or until the main fermentation is over; then close the vessel. The beer can be used after about three days.

Sweet Apple Cider, of brown sugar, cider flavor, and water. Yeast is added to produce fermentation. To improve the article add rectified spirits. To give it a champagne taste, add two or three bruised raisins.

The above are only a very few of the receipts, which number over two hundred.

The flavors and ethers mentioned are sometimes mixtures of two or more of the compound ethers, experience teaching the "druggist" the kinds, and the proportions of each kind, necessary to produce the taste of the wine or other liquor it is desired to imitate.

The question naturally arises if these factitious liquors can possibly be palmed upon any persons as genuine. A letter on this point from the druggist who issued the receipts, reads as follows:—

"PHILADELPHIA, Dec. 10, 1872.

"——— ———, Esq.

"DEAR SIR:—We are in receipt of your favor of this date. In reply we would state that good judges of liquor could of course detect the difference between genuine imported liquors and those artificially flavored, though it is very difficult for any one but a first-class judge to distinguish them. They are sold by the greater part of the trade whenever medium or lower price goods are wanted. They improve very much by age. We think you would have little difficulty in selling them to all except your very finest trade.

"We make a specialty of keeping all kinds of drugs, &c., for liquor dealers.

"We remain, very truly, yours.

"——— ———."

It is considered unnecessary to discuss the question if these factitious liquors are deleterious: it is, however, important to know if they are made and sold in this city and State.

For information on this point, the writer has depended upon the statement of persons who have had occasion, in an official capacity, to test the character of alcoholic liquors sold in Massachusetts.

It appears to be true that the greater portion of the impure alcoholic liquors sold in the State, is adulterated by the addition of alcohol and water only. The artificial liquors are manufactured by a limited class of persons. These are not, generally, the wholesale dealers nor the better portion of the retail dealers, but the lowest class of the latter, in the obscure parts of the cities, and in the smaller towns, where the number of such manufacturers is proportionately larger, probably, than in the cities.

TARTARIC ACID AS A SUBSTITUTE FOR FRUIT.

It has already been noted that tartaric acid, and also citric acid, are employed as a substitute for lemon-juice in the

manufacture of lemon sirup, and that they are sometimes used to give tartness to jellies artificially flavored. But tartaric acid is sometimes also employed as a substitute for fruit in pies and tarts, and it is now, in this vicinity at least, put up in boxes and sold for this purpose under the name of "Fruitina." It may be found upon the counters and shelves of many of the grocers of this city, and is recommended in the following terms :—

Important to Housekeepers.—Found in Fruitina, a perfect substitute for fruit for all kinds of pies and jellies! Twenty-five pies for thirty-five cents! One package will make twenty-five pies that cannot be distinguished from those made of fruit, mince, apple, lemon or pumpkin. The jellies made of Fruitina are unsurpassed for beauty, transparency, richness and freshness of flavor. It saves all the labor of preparing the fruit and is far cheaper. The cook will be delighted with it because the baking is so quickly accomplished. Try one package and be convinced of its wonderful merits. Warranted to perform all that is promised for it. One package makes twenty-five pies or sixteen pounds of jelly. Price thirty-five cents per package. Full directions accompany each box.

Sold wholesale by Henry W. Putnam, Oxford, Mass.

P. S. Warranted free from injurious ingredients.

For sale by all grocers.

Read! Read! Read! A Card to the Public.—This preparation is wholly composed of fruit and vegetable substances, and is warranted to contain no injurious ingredients, and to be perfectly harmless. The money will be refunded, if in any case, after thorough trial, satisfaction is not given.

Read the following notices from the press :—

An agent for H. W. Putnam, of Oxford, Mass., is introducing to the notice of our citizens, a new article in the way of a substitute for fruits for all kinds of pies and jellies, &c. We have tested its merits and are satisfied that it is as good, if not a little better, than the real thing. [*Nashua Daily Telegraph*, Dec. 20, 1871.

We wish to call particular attention to a new substitute for fruit in cooking, advertised in this paper, put up by Henry W. Putnam, of Oxford, Mass. In order to satisfy ourselves as to the merits of this preparation before recommending it, we procured a box and submitted it to trial under the direction of an experienced cook. We can truthfully say that the trial was in every way satisfactory, and we are willing to stake our reputation on the merits of Fruitina. [*Douglas Herald*, Dec. 30, 1871.

See the following testimonials :—

We, the undersigned, have thoroughly tested the merits of Fruitina, and it has proved in all respects satisfactory. We recommend it to the public as a perfect substitute for fruit.

Here follow some forty names of women, several of whom are represented as keeping boarding houses. There is also one "proprietor of dining-rooms."

"Directions for using" accompany each box of "Fruitina," and it is worth while to copy one or two of them.

Apple Pies.—Dissolve one teaspoonful of Fruitina and one cup of sugar in two cups of cold water. Have ready three plates lined with crust, and fill with the mixture. To each plate add one cracker, broken in pieces about the size of slices of apple; add salt and any spice you prefer; cover and bake.

Pumpkin Pie.—Three tablespoonfuls of molasses, a quarter teaspoonful of Fruitina, one quart of milk, two eggs, three rolled crackers; then add spice, and sweeten with sugar to your taste.

Jellies.—Four heaping tablespoonfuls of common starch and one teaspoonful of Fruitina, rubbed smooth in a little cold water; add one pound of sugar, and pour over it, stirring rapidly, one pint of boiling water; let it boil gently about ten minutes, taking care that it does not burn; remove from the fire and flavor with anything you prefer. Pour in moulds and cool. The above quantity of starch may not always be found correct, as there is a great difference in the gluten of the article. Jellies made from this recipe are fully equal in every respect to those made from fruit at far more expense and labor.

This use of tartaric acid has undoubtedly been stimulated by receipts, in which it enters as an ingredient, which have appeared from time to time in farm journals and other publications. Within a short time one of these receipts was met with in a weekly publication in Boston. Under the head of "Our Recipes," which included "Mackerel Pudding," "Rich Cake without Eggs," and a Yorkshire receipt called "Fat Rascals," is one for "Imitation Lemon Pie,"—"A very good imitation, so far as taste is concerned, of a lemon pie, can be made as follows: Pare and boil a turnip, add a teaspoonful of tartaric acid, and a cup of sugar; season, and bake as an apple pie."

Tartaric and citric acids cannot be considered as poisons, and they may be swallowed in considerable quantity without fatal results. Moreover, as has already been intimated, they may, dissolved in a proper amount of water, be taken occasionally in the hot season, with advantage. They also make a refreshing drink in fevers. It is, however, a cheat to use either of them as a substitute for fruit in the domestic economy, and it is not unlikely that they may do harm if partaken of too freely.

There some other substances which are occasionally used as flavors in articles of food and drink, in this vicinity as elsewhere,—but they are generally employed with the tacit

consent of the consumer and are, also, not injurious. Vanilla in chocolate and sage in cheese may be mentioned as examples. In other cases, substances are employed without the tacit consent of the consumer. Of these liquorice in the extracts of coffee and in beer may be mentioned. The former flavoring adulteration is very common, the latter rare.

It may oe well to notice the commonly entertained opinion, that strychnine is often used to give a bitter flavor to ales and beer. The writer has made some effort to determine this question, and the result of his inquiries is his belief that the popular idea is entirely erroneous. It is probable that in no brewery in this country is any other substance than malt, hops, and water employed in the making of beer, if the very rare use of liquorice may be excepted. As regards the ales which are imported from England, it is an established fact that they are absolutely pure. Some years ago, on account of accusations made by certain persons in France, two of the largest manufacturers of ale in England invited an examination into the character of their productions, with special reference to the presence of strychnine. The strictness of the investigation was such as to preclude the possibility of error, the specimens of ales analyzed being obtained in various parts of the kingdom, and the brewings bearing various dates, all previous to that of the appearance of the accusations. The examiners were chemists nominated by "The London Lancet," and the verdict was that hops, malt, and water alone were employed in brewing the specimens of ale examined. The ales of these two establishments are more largely imported into Boston than those of any other foreign brewery.

Spontaneous Change in the Extract or Essence of Vanilla.

The vanilla-flavor, so much used and so highly prized, is given to articles of food in two forms; first, in that of a powder of the pod; and secondly, in that of its alcoholic extract. There is no reason to believe that either the pod itself or the extract is deleterious when fresh, but there is strong reason to fear that the extract, at least, may undergo a change so as to be capable of producing poisonous symptoms. What this

change is, is not yet known, but it probably takes place through oxidation, after exposure for a length of time to the air.

The following is from the "Medical and Surgical Reporter," date unknown :—

"The German medical journals call attention to the circumstance, that several cases of poisoning by vanilla-ices have in late years occurred in Paris, Altona, Munich, Vienna, and other places. Maurer has recently related an instance in which, after the use of these ices, a large family suffered from the symptoms described as having been present in the other cases, viz., frequent vomiting and diarrhœa, assuming in some of the patients a choleriform character. All the patients recovered. What the nature of the poison is has not yet been ascertained. In two observations on the remaining portions of the poisonous ices traces of lead, iron and tin were present; * but the combination of lactic acid with oxide of tin has been ascertained not to be poisonous. Schroff believes that the poison is produced by the use of cashew-nut oil to besmear the vanilla-pods."

The following account is from the "Boston Medical and Surgical Journal," of June 27, 1872.

"*Poisoning by Vanilla-bean.*—Messrs. Editors,—In the 'Journal' for May 30th there is an extract from the 'Medical and Surgical Reporter,' on poisoning by vanilla flavoring. It is there stated that Schroff believes that the poison is produced by the use of cashew-nut oil to besmear the vanilla-pods.

"Having been poisoned myself a few years ago,—together with eight or nine other person in my family,—by 'the extract of vanilla,' I was led to institute inquiries as to the cause, and arrived at a different conclusion from the above. The food which sickened those of my family who ate of it was custard flavored with the extract of vanilla. The bottle from which the extract was taken had been opened some months previously, and a part of it used at that time without producing any ill effects.

"By inquiring among my friends, I learned that one of them, together with a large family of which she is a member, had been poisoned by food flavored with vanilla-extract, which was stale, and which had been exposed to the air for some time.

"As the same manufacturer's extract of vanilla had been used in my family for years without bad effects, and a portion of the same bottle had been consumed some months before without producing any sickness, and as we have since used the same flavoring for ices and food, prepared by the same parties, taking care only to use it fresh, and only in the above instance have been made ill by it, I have come to the conclusion that a change takes place in the extract when exposed for a time to the air, and that this develops some poisonous properties. HAMPSHIRE."

* Probably from minute particles of the soldered tinned-iron vessel in which the ices were made. Such particles are undoubtedly present in all ices in infinitesimal amounts.

It is not generally known that the low-priced extracts of vanilla in the market are made, wholly or in part, of the tonka-bean, a cheaper article which is somewhat used for flavoring snuff. There is, however, no reason to suppose that this bean possesses any deleterious properties.

BOSTON, December, 1872.

DRAINAGE FOR HEALTH.

By HENRY F. FRENCH, of Concord.

DRAINAGE FOR HEALTH.

It appears from the Reports of the State Board of Health, that at least one-half of the annual deaths in Massachusetts may be referred to three groups of causes; namely, consumption, typhoid and contagion. "An examination of the deaths from consumption in Massachusetts, during ten years (45,000 cases) shows that its distribution in the various towns is very unequal, in some of them the mortality from this disease being two and even three times the number found in others of equal size, and equally stationary population, representing all ages. Dr. Bowditch has clearly shown that among the prominent causes of consumption is exposure to soil moisture." (First Report, p. 46.)

As to the second group, we are told by Dr. Derby: "There can be no doubt that typhoid in Massachusetts is a disease of scattered communities rather than of crowded towns, of rural rather than of urban districts. In spite of the smaller mortality from all causes, typhoid is more destructive in the farming towns, than in the manufacturing towns and the large cities." (Second Report, p. 118.)

The results of all investigation seem to point to the decomposition of vegetable substances as a chief cause of typhoid fever in this Commonwealth. "Whether the vehicle be drinking-water made foul by human excrement, sink-drains or soiled clothing, or air made foul in enclosed places by drains, decaying vegetables or fish or old timber, or in open places by pigsties, drained ponds or reservoirs, stagnant water, accumulations of filth of every sort, the one thing present in all these circumstances is decomposition." (Second Report, p. 178.)

It seems to be equally clear that even contagions and epidemics usually select for their victims those whose systems are debilitated and so predisposed to disease, by want

of pure air and pure water as well as nourishing and sufficient food. That there is some good reason why three times as many persons die of consumption in one town as in another of similar population, and why typhoids prevail more in the country than in the city, we must all admit, and it is surely far more rational to look closely at home to ascertain whether our families are drinking diluted sink-water or breathing malaria, than to resent as an insult the suggestion that our diseases are the result of our own carelessness, as the natural man seems generally ready to do.

It has been truly said, that no man is so poor that he need have his pig-trough at the front door, and if we cannot single-handed drain a town, we can at least keep decent our homesteads.

We see that the well are made sick, and the sick are made worse for want of the two elements which a good God has given us absolutely without measure,—pure air and pure water. From toothaches to typhoids, from the neuralgias and rheumatisms that keep us in torment and will not even let us escape by death, to the fevers and cholera, which strike us down almost without warning, and even from consumption, slow but sure, we suffer in great measure, because we breathe bad air and drink bad water. We see too, that often, if not usually, the air is poisoned by emanations from stagnant water, either that which is naturally in the soil or in pools and holes about us, or that which we have rendered corrupt by the ordinary and careless arrangement of buildings for our families and our domestic animals.

The water of our springs and wells is corrupted by drainage from cesspools and sinks, so that we ourselves often systematically poison both the air we breathe and the water we drink.

The chief object of this paper is to show to people living in the country, how practically to render their homes more healthful, by draining off the natural surplus-water from their building-sites and surroundings, and by carrying away and rendering harmless and even useful the outflows of sinks, and of drains from chambers and water-closets.

The subject has not indeed in all respects a pleasant flavor,

but physicians and boards of health cannot well treat all diseases or their causes with rose-water alone.

Drainage of Building-Sites.

Many of our villages are upon ground which is naturally wet, either because it is flat and low or because it is on a hill-side, so that the rainfall is a long time in soaking through the soil to its outlet in some pond or stream. We have about forty-two inches of rain in a year, and this immense quantity must go off either by running away on the surface, by evaporation, or by percolating slowly through the soil.

We have therefore, ponds or small pools of water, swamps large and small, and much land hard and firm yet filled nearly to the surface with stagnant water. Land in which water will be found at a depth of two feet in any part of the growing season needs draining for agriculture. Land in which water is found at any season within four feet of the surface needs draining for health.

The principles and processes applied to the drainage of building-sites and their surroundings, are the same which are applied to ordinary farm drainage. The object is, at the least cost, to relieve the soil of surplus-water, or water that is not held by attraction, or in plainer terms, water that will run out of the soil. Ordinary soil, thoroughly dried, will receive about half its bulk of water before any drains off, so that three and a half feet of such soil may hold by attraction half the rainfall of a year.

We are here dealing only with clear water, to be conveyed in pipes that may take in or let out water at every foot, and such drainage is entirely distinct from the drainage of sinks and the like, which requires pipes much larger and smoother and also close-jointed and far more expensive, as we shall show under another head. And it should be said that this paper does not in any way relate to the sewerage of towns or cities, a department which belongs to skilled engineers, but is meant only to contain some hints to dwellers in rural homes.

As our space is limited, we must ask the reader to be content on many points, with simple rules and directions without discussion of reasons. If more than this is desired he

will find the subject fully elaborated in a book on "Farm Drainage" by the writer of this paper.

To drain a tract large or small, one acre or ten thousand acres, find an outlet low enough to give the necessary fall. One foot in one hundred is sufficient, and we have drains working well that have but a quarter of that fall. If the fall is slight, the greater care will be necessary in laying out the work and in performing it.

Common drain-tiles are recommended, rather than stones or wood, and the directions given are specially adapted to the use of tiles. They can be purchased in Boston and Albany, and many other places, at a cost of two cents each for two-inch, four cents each for three-inch, and six cents each for four-inch; and these are the only sizes necessary. They are usually about twelve inches long. If the four-inch are not large enough, two or more lines of them abreast may be laid. We have laid miles of drains and never used a conduit larger than a single four-inch pipe. Tile-drains are cheaper and more durable than stone,—cheaper because the excavation for them is much less, because they are more easily transported and laid in place, and because there remains no surplus earth to be removed; more durable, because they keep out sand and moles and frogs and other creeping things, which always destroy stone-drains, and tiles burned like hard bricks will last forever. If tiles cannot be procured, stones or bricks or wood may answer the purpose.

The work should be all laid out before breaking ground, and in general a day's service of a competent engineer to lay out the work and fix the grades, will be worth far more than it costs. Usually a single main drain should run through the lowest part of the tract, and it is not important that the main should be straight. Having laid out the main, lay side-drains running into it, having in view two principles: first, to run each drain up and down the slope of the land rather than across; and second, to have them parallel to each other. Like most principles, we shall be compelled often to compromise them. The depth should be four feet or more, and the distance apart, with this depth, may be from thirty to fifty feet. In any soil, except a close clay, fifty feet apart will be a safe distance.

To open them, begin at the outlet, so that the water may run off as the work proceeds, and with a common spade, and a pick if necessary, cut a trench by a line, eighteen inches wide at the surface, narrowing to four inches, or the width of a laborer's boot, at the bottom. The laborers will insist that they cannot work in so narrow a trench, and probably convince their employer, who of course has a right to follow their advice and waste his money if he pleases. To finish the bottom, a spade four inches wide is needed, and may be made by getting a blacksmith to cut down a common long-handled spade to that width, no wider at the heel than the point. This is the only peculiar implement necessary, all the assortment of "draining tools" being only valuable to sell. Having opened all the drains, keeping the main low enough to let off the water, we begin to lay the tiles at the upper end. If there is much fall and there is danger that the main or the lower end of it may cave in, it may be only partially excavated at first, just enough so that the water may run off from above.

Lay the first tile, usually of two-inch size, with a brick or flat stone over the upper end to close it entirely, and the next end to end with it, and so on to the main, keeping always an inclination, however slight, for if any depression is made, the silt will lodge in it and obstruct the work.

Here let this idea be fully impressed. In this system of drainage, no water is to be anywhere admitted except by percolation through the soil. There is to be no opening to the surface, or into any ditch, or to receive sink-water, or anything but clear water creeping underground.

But how does the water get in? Chiefly at the joints, which are as close as two rough bricks laid end to end would be. Nothing short of cementing the joints can keep the water out. The great difficulty is to keep out silt or fine sand.

Having laid two or three tiles on the bare earth, if hard, and on laths or other thin wood, if soft, cover each joint half or more round the tiles with a piece of tarred paper as large as a common letter-envelope, and holding the whole firmly, place soil or gravel over it and on both sides of the tiles, pressing it enough to keep them in place. However tempted to do so, put no stones nor straw nor shavings into the drain.

Cover and fill up with anything at hand, except soft clay or fine sand, which should not be placed in contact with the tiles. Most of the tiles used in Massachusetts are sole tiles, having a flat bottom and egg-shaped orifice, the small end of the egg downward. Round tiles have the advantage that they may be turned so as to get a better joint, but the require more care in laying, unless collars are used, and this adds fifty per cent. to the cost.

When we approach the junction of the minor drain with the main, a curve should be made, so as not to bring in the side-stream at right angles. Branch tiles may be found made for the purpose of junction, and these are much better than any home contrivances.

The capacity of pipes with round bores is nearly in proportion to the squares of their diameter. The square of two is four, and the square of four is sixteen, so that a four-inch pipe theoretically carries four times as much as a two-inch pipe, and actually carries more, the friction being less in proportion in large pipes. Again, water running down hill in a smooth pipe gains by accelerated velocity as any falling body does, and the stream grows smaller as it flows swifter, and so requires less space to carry it. If, however, a pipe be running full this acceleration is retarded, because the stream cannot lessen its bulk without leaving a vacuum. The admission of side-streams fills this vacuum, and thus allows the main stream to run faster.

With considerable fall, the main pipe may in fact be much smaller than would seem possible without reference to these principles. In one case in England it was found by actual experiment, that the addition of eight junctions, each of three inches diameter, into a main line of pipe of only four inches diameter, so increased the velocity of the stream that there was no increase of its sectional area. Even if the fall be slight, the pressure of water above, as soon as the pipe is full, vastly increases the velocity of the stream, so that it is rarely necessary to use pipes larger than three or four inches.

Having thus connected the drains in one system with only one outlet, this should be so secured by a wire grating that no frog or other creeping thing can explore it, and it should be built up solid with stone, so as to be permanent, and

should have a clear fall of a few inches upon a flat stone that it may not be obstructed by back-water and mud.

We have been thus precise in our directions how to drain a field or building lot because the same rules are applicable to the drainage of buildings.

How to Drain Cellars.

Did the reader ever when a child see the cellar afloat at some old home in the country? You creep part way down the cellar stairs with only the light of a single tallow-candle, and behold by its dim glimmer an expanse of dark water, boundless as the sea. On its surface in dire confusion float barrels and boxes, butter-firkins and washtubs, boards, planks, hoops and staves without number, interspersed with apples, turnips and cabbages, while half-drowned rats and mice scrambling up the stairway for dear life drive you affrighted back to the kitchen.

In a large proportion of the houses in some old villages in Massachusetts there is no provision whatever for any drainage of the cellar, and in thousands of houses the water as often as once in three or four years covers the cellar bottom, sometimes to the depth of two or three feet, and remains several weeks, gradually settling away as the general water-table of the town is drawn down by the subsidence of the freshet. In sandy plains the water lies usually nearly level, with a slight inclination toward some stream or pond or swamp, into which it slowly percolates through the ground. The water will, in such cases, be found at about the same level in all the wells and cellars. It rises into them as the ground is filled precisely as it rises in a well.

In soils with a bottom of clay or hard-pan, slowly pervious to water, it will often pond in the cellar when far from the surface in wells near by. The great spring-rains, with melting snow, have not time to soak down through the close soil, and the water seeks the nearest outlet from the overcharged soil, and finds it in the cellar, the bottom of which is too compact to allow its escape as fast as it enters.

Now consider the condition of one of these old farm-house cellars that has been in use fifty years or more. In it have

been stored all the potatoes, turnips, cabbages, onions and other vegetables for family use. The milk and cream, the pork and beef and cider and vinegar have all met with various accidents, and from time to time have had their juices in various stages of decay absorbed by the soil of the cellar bottom. The cats, so neat and peculiar in their habits, have slept there to fight the rats and mice, who have had their little homes behind the walls for a half century, and the sink-spouts have for the same term poured into the soil close by, their fragrant fluids. The water rushes upward and sideway into the cellar, forming with the savory ingredients at which we have delicately hinted, a sort of broth, quite thin and watery at first, but growing thicker as the water slowly subsides and leaves its grosser parts pervading the surface of the earth, walls and partitions, and the floors above fully saturated. All this time the air rushes in at the openings of the cellar, and presses constantly upward, often lifting the carpets from the floors, and is breathed day and night by all who dwell in the house. Does it require learned doctors or boards of health to inform any rational person that these conditions are unfavorable to health?

The most common method of draining a cellar of a New England country house is to construct a small stone culvert running from the lowest corner of the cellar to some low place a few rods distant, and digging little trenches across the cellar bottom in various directions leading to this outlet.

This is expensive and very imperfect, though better than nothing, as the water cannot rise so long as the drain remains open. Such a drain, having a flat bottom, and admitting floating particles of wood or vegetables, readily clogs, and it only removes water which is above the surface, leaving the cellar bottom muddy like a highway in spring-time, and requiring planks and boards to render the path tolerable. Small animals pass through such drains at pleasure, and in one instance we knew of a muskrat being caught foraging in a cellar which he had thus entered.

The cheapest and the best mode of draining a house-cellar, in most cases, is that adopted by the writer on his own premises in two instances. It is in fact a mere application of the ordinary principles of field-drainage already illustrated.

The writer purchased a farm in Concord, on which was a house which had been built about seventy-five years. It had no drain whatever, and it seemed to be generally agreed that once in two or three years water had always stood in the cellar, sometimes two feet deep. The occupants had been intelligent, wealthy farmers,—two or more generations of the same family,—who seemed to understand everything but drainage. Having taken levels, it appeared that a low tract on the opposite side of the highway gave sufficient fall for our purpose. A trench was opened from that point across the highway to the nearest corner of the cellar. We tunnelled under both walls and under the roots of very large elm and ash trees, and under the cellar-wall, going about four feet deep except near the house, where we went nine feet deep. The subsoil all the way was sand, very easily moved. In the cellar the drain was continued around the big chimney in the middle, to the farthest corner, about one foot below the surface. In the cellar were laid common two-inch drain-tiles, to the corner where the drain goes out under the wall. There three-inch tiles were used across the street about one hundred and seventy-five feet, then, as the soil was springy, four-inch tiles were used fifty-eight feet more to the outlet. The joints were covered with tarred paper, exactly as in field-drainage, and the soil was returned and levelled, the outlet was secured by a little wall of stone, and a copper netting was put over the last tile, and the work was done.

Let it be understood distinctly that the drain is covered all the way. There is no opening in it except the grated outlet. There is no place where a mouse or even a fly can enter. The air cannot draw through it except as it passes up through a foot of earth. It was laid in November, 1867, and in the same season a furnace was put in, with its ash-box level with the cellar bottom. The tiles for the two hundred and thirty-three feet cost $10.86, and the labor $10.50; in all, $21.36. This was the whole cost of what appeared to be a great work; except the small tiles and labor in the cellar, not more than would make the whole cost $25. The result is that there has never since been a drop of water visible in the cellar, although the spring of 1870 was one of the wettest seasons known, and many cellars in Concord were flooded.

In May, 1868, by careful measurement, the water in a well within twelve feet of this cellar was two feet above the tiles in the cellar bottom, the four-inch pipe running two-thirds full at the outlet, yet the small pipes in the cellar were sufficient to keep down the water, which in old times would have covered the cellar bottom a foot deep.

A cellar at Exeter, N. H., drained in precisely the same way twenty-two years ago, has been perfectly dry ever since, without any attention whatever being given to the drain, which will probably be as lasting as the house itself.

Often buildings are place on a slope or hillside, having a subsoil not readily permeable by water. In its natural state the surface-soil may be open enough to be sufficiently dry for cultivation, as the water from rains in the growing season may pass downward out of the way, and run off upon the underlying stratum. But a cellar is sunk four or five feet and stoned up, and forms a reservoir which catches the water flowing in the soil, and holds it for weeks or months until it passes slowly downward. In such a case it is often practicable to catch the water before it enters the cellar, and so avoid all dampness, by running drains on one or more sides of the building outside the walls.

In several instances the writer has suggested this idea to occupants of valuable houses, in the cellars of which the water unaccountably collected, when all the soil around seemed dry, and an easy remedy was afforded. In the fall of 1870, Mr. Marsh, the superintendent of the state almshouse at Tewksbury, called to see if any way could be devised to relieve the new structure there of a very serious invasion of water. The building is of brick, one hundred and twenty-five feet long and three or four stories high, and a large dining-hall runs through the basement, the floor of which, on one side, is some two feet below the ground. It was found that the floor of the dining-hall was flooded with water in the wet season, and it had been suggested to take out the floor and cover the soil under it with a heavy coat of cement, and cement the side walls, and so exclude the water. Mr. Marsh hoped to find a cheaper remedy.

Having a sort of contingent interest in the state almshouse, we went over and examined the matter. The building

stands upon elevated ground, but upon a broad slope toward the north. The land rising from it toward the south is apparently dry and is under good cultivation. It was at once seen to be one of those instances where the water from rain passes through the surface-soil and flows along the closer subsoil.

We advised the superintendent not to disturb his floor, but to open a narrow trench as near to the building as was safe, running parallel with it and two feet below the lowest foundation-stone, with a slight fall toward the west, where there was sufficient descent, and to lay in the trench a single line of three or four-inch drain-tiles, and to fill the trench with gravel or coarse sand.

The drain being designed for a catch-water, it would not be prudent to fill it with clay or compact soil, because in a great flush of water it might pass across the drain above the tiles, especially as the drain must be quite deep. We heard no more of Tewksbury almshouse till this paper was commenced, when we wrote to Mr. Marsh, inquiring about the matter, and he called and made report. He, with only common laborers, opened the trench six feet from the building, and two feet below the foundation, making it from five to eight feet below the surface, and 225 feet long and laid it with four-inch tiles and covered them as directed. There has been a great flow of water in all wet seasons from the outlet, and the floor of the basement has been perfectly dry ever since. An addition 125 feet long has been made on the west side, and the drain answers for the whole extent of the building, 250 feet. The tiles cost four and a half cents each, or about $10 in all, and all the other cost was the labor of opening and filling the trench.

The idea of cementing the floor and inside of the wall of a cellar or basement to exclude water is very common. The pressure of water is in proportion to its height or head, without reference to the extent of its surface. If then the water be heaped up behind a cellar-wall to the surface, we have a pressure equal to that of a mill-pond against its dam seven or eight feet high. No sane man would think of tightening a dam of that height by plastering the down-stream side of it

with cement. We have seen one instance where a cellar was carefully and heavily cemented to exclude water, and the pressure of the water lifted the whole body of the cement from the bottom, leaving it in broken masses, like flagstones half on edge. It is certainly practicable to exclude water from a cellar by a heavy wall laid in cement, and a heavy cemented floor of brick or stone, but the process is very expensive, and leaves the adjacent soil saturated with water in wet times.

What makes the Water Bad?

Hundreds of people in the country are asking this question constantly. If we abruptly reply, "Because your sink-drains and vaults empty into it," the truth would usually be spoken, but the seed would fall on stony ground. The very horror of drinking such pollution leads one to exclaim, "Is thy servant a dog," and to turn away in indignation. It seems an insult to be told that we are guilty of such gross carelessness in a matter so vital. We must, therefore, approach the question more circumspectly. That there is a good reason why the water of a well which has been used for years suddenly becomes offensive to taste and smell, all must admit. There must also be a reason why it is sometimes much more offensive than at other times, as is usually the fact.

There are certain principles that must be kept in mind in such investigations. Common soil is one of the best deodorizers. It will absorb and retain a great amount of corrupt and decomposing matter, depending much on the character of the soil. It may, therefore, be a long time before the deposits in the soil, however foul, will extend even twenty or thirty feet. Bearing in mind, however, that the clouds give us three and a half feet in depth of water annually on every foot of our land; that, in addition to this, all that falls on our buildings is poured down upon the soil near them, and that all that is used in kitchens and wash-rooms is added thereto, and we see that there is a flood of water which goes somewhere. The water in the well stands ten to thirty feet below the surface. We know that drains in our fields, four feet deep and fifty feet apart, carry off all the water of the heaviest

rain in forty-eight hours, merely because the water, by gravitation seeks the lowest outlet. It is a general rule in drainage that drains draw water from distances in proportion to their depth. A well therefore operates as a very deep drain. No water will be found near it, without digging to the level of the water in the well. The well drains all the soil in its neighborhood. Whatever fluid permeates the soil tends towards the well, and the problem is whether the soil through which it passes from vaults and sinks and stables has capacity to purify it on the way, so that it is fit for daily family use.

The subsoil is usually more compact than the surface-soil. Clay frequently underlies sand at a depth of a few feet. The subsoil has generally an inclination or dip, and the water tends down the slope upon the more compact subsoil, just as it would run on a compact surface, only slower. Careful observation will teach us the direction of the underground water, and it is always safest to dig our well on the up-stream side of the buildings, so that the tendency of the natural drainage from them may be away from the well. This is especially necessary in sandy soils, in which the wells are shallow, and are usually dug but little into the hard subsoil, which stops the downward passage of the water so that we come to water when we reach the stratum which stops it.

And now what practically shall we do to keep apart our vaults and sinks and barn-cellars from the wells? A shallow well in sandy soil is far better laid with brick in cement, than with stone in the ordinary way. We may thus exclude all water except what passes in at the bottom, compelling all the water to filter through the soil to the depth of the bottom of the well. Well-water is usually worst when lowest. When the water stands as high in the well as in the vaults and cess-pools near it there is no drainage from one to the other. Besides, when a given quantity of filth is dissolved in a great deal of water we do not so readily taste or smell it. When the water is low in the well and then is rapidly pumped out, all the fluids in the neighborhood rush to supply its place. If, however, the intervening soil is dry enough to absorb the foul water the filth may not reach the well till rain enough falls to

carry it along. We should expect bad water from such causes in or just after a drought.

As to common privy-vaults, lay them with brick and cement carefully, water-tight, of capacity say of forty to eighty cubic feet for a common country house. Fill one-third full of dry soil of any kind except sand, and add more from time to time, clearing it out two or three times a year for use in the garden or field. If no water is drained or poured into it, the contents will be dry and inoffensive enough to be shovelled into a cart at any time. This will be an improvement on the common arrangement. It is throwing slops into such a vault that makes it offensive, and this must never be allowed. A bed of muck or soil hollowed in the middle upon which, through a spout or otherwise, the chamber-slops can be poured, if occasionally changed, will absorb their odor and add value to the compost-heap. Every house, however, should, have upon the level of its chamber-floor conveniences of a better kind. As such arrangements are not within the scope of our subject they will not be here discussed.

Sink-Drains.

A great many instances have come to our notice of wells polluted by sink-water. In one case, in midwinter, a neighbor informed us that his well had become too bad to use. It was forty feet from his sink-spout, which emptied into the ground. The soil was loose sand on clay, and the well about ten feet deep. He could not believe that the sink-water reached the well, but as he could not use the water, and wells are easily dug there, he sank another on the other side of his house and found good water. The following spring he found the sink-water had stained the soil all the way straight to his first well. In this case the buildings had been occupied but two or three years.

It is hoped that the reader has supped full of horrors long enough to feel an interest in the practical means of getting rid of sink-water. There is no fluid so hard to carry away. The soap and grease are deposited on the sides of the pipe, and it may be said to be a mere question of time, depending on the size of the pipe, how soon it will fill up. This is why

the drainage of clear water should be kept distinct from that of cesspools and sinks. Clear water will flow in half-inch pipes, while four to six inches is small enough for sinks and cesspools, and the joints of the latter must be tight, while common drain-tiles are open.

We will describe a method in successful use for five years with no obstruction whatever, with a fall only about one in a hundred. It is cheap, efficient and durable, and requires little skill in construction.

At the sink is a common bell-trap. A lead-pipe of one and a half or two inch bore runs down and out through the cellar or ground into a reservoir, which may be a strong oil-cask of fifty to a hundred gallons, or of very well cemented hard brick. It should be a foot or more below the surface, so that, properly covered in winter, it will not freeze. The lead-pipe should discharge under water, and so we have a second trap that prevents any air passing up the pipe. The outlet-pipe, starting about one-third up from the bottom, may be of lead, one-half to two-inch bore, and should run upward and out of the reservoir at about a third from the top and into a large pipe of stone or iron. Thus the water enters the lead-pipe about midway from top to bottom, leaving the greasy particles floating on top and the heavy particles at the bottom, so that what runs off is comparatively clear. It still carries off a great deal of soap, and will deposit it for a long distance. At our own house a five-inch stone-pipe runs one hundred feet to the barn-cellar, where it is again trapped in a cask, and carried thirty feet further to the manure-heap under the stable, far enough and low enough to keep it out of the well. The large pipes fit into each other, and are made tight with cement. They should be carefully laid, keeping always a slope, and a swab should be used to rub down the cement inside as each joint is laid. Three or four times a year the cover of the reservoir should be removed and everything cleared out.

The final deposit or cesspool into which sinks and water-closets are discharged should be placed, if possible, below the level of the water in the wells at their lowest, and always on the down-stream side of the well, as the water is supposed to

flow in the ground. A large vault, cemented or not, as seems necessary, may be supplied with a quantity of dry soil or peat, and the moisture may be thus absorbed, or a trap may be there arranged which shall separate the fluid, which may be pumped out and applied to the soil; or the moisture may be absorbed by the earth, if the conditions are such as to render it safe.

A judicious application of the principles given will enable a man of ordinary common-sense to take the precautions essential to health, so far as relates to drainage.

INFANT MORTALITY.

By EDWARD JARVIS, M. D.

INFANT MORTALITY.

The perfect child comes to the world with all its organs in complete condition,—the stomach to digest its food, the heart to circulate the blood, the lungs to purify it, the nutrient arteries to convert it into flesh, the skin for protection, the bones and muscles for motion, and the brain to preside over all.

"Death in childhood is an unnatural event, inasmuch as the regular series of development of the human structure, from the germ-cell to the perfect man in his prime and in his last declining stage of existence, is interrupted."

"But life, at all ages, depends upon so many conditions, and is exposed to so many risks, that out of given numbers of living some die at every age, and we can only take for a practical standard the lowest authenticated rates of mortality." *

This is the physiological view of the early condition of man.

There is no gift to humanity so great, so valuable, none that offers so rich a source of happiness and comfort, as a child to a parent. There is nothing of which so much may be made. There is no such treasure offered; no such responsibility placed upon a family.

The child is the promise of all the hereafter. The whole future of the world is wrapped in him. Unless he fulfil this promise and grow to manhood, the family ceases, the state perishes, the human race comes to an end. The family have the intensest interest of affection in his preservation, and all the pride and power of the nation rests upon his life.

But as soon as the child appears among us, with all the promise of life, it is beset with manifold perils, that assail its vitality and tend to destroy it. These influences of evil appear on every side, to which it has but little power of resistance. Although perfectly organized and endowed with all the means of carrying on the processes of life, the child is fragile, it has a small amount of vital force and requires

* Reg. Gen. England, Supplement to 25th Rep. p. ix.

favorable conditions and incessant care to protect it from the dangers that may threaten it.

Death then begins at once to assail these hopes of man, and in the first week, the first month, the first year, and onward, children perish in large numbers.

Beaugrand says :—

"For a long time hygeists have been occupied with the enormous mortality of infants in their first year. A great number of works have been published on this important question. Statisticians have been called to aid in the explanation of the complex condition of this social problem."

Everywhere in the world, and in all ages from the beginning, there is and has been the great cry of disappointment and sorrow at this great loss. There is and has been a great diversity in the mortality of children in various places. These differences are connected with varying conditions and circumstances. The seasons, local and endemic influences, and more than all, the means and manners of life in the family seem to be prominent as friends or foes, to aid or impair the infant constitution, in its struggle against the adverse influences that threaten it.

To the wise and the faithful are accorded the best results of their endeavors, to save their infants from destruction. But no community is free from this danger or loss. The records of all nations show a large proportion of the children that perish, on the way, from birth to maturity.

Massachusetts is one of the most favored States in the world for the intelligence, at least of its native population, and for their thrift and wisdom in management. In this Commonwealth, during the fifteen years ending 1870, there were 514,233 children born; and 71,526, or 13.91 per cent. of these died in their first year, and 131,784, or 25.52 per cent. before they had completed their fifth year. This includes the record of the foreigners, whose infant mortality was in a larger ratio, as well as that of the native families whose infant mortality was at a lower rate, than this average.

The following table shows the experience of most civilized nations in this respect :—

* Annales de l'Hygiene, 2d series, xxiv. 218.

Showing the Births and Deaths under one and under five, and the ratio of each to Births.

COUNTRY.	Period.	Births.	Deaths.		Ratio of Deaths to Births.	
			Under One.	Under Five.	Under One.	Under Five.
Massachusetts,[1]	1856–1870,	514,233	71,526	131,784	13.91	25.62
Michigan,[1]	1868–1870,	78,786	–	11,072	–	14.05
England,[1]	1851–1860,	6,471,650	996,630	1,706,583	15.40	26.37
Scotland,[1]	1855–1868,	1,331,250	180,363	353,906	13.55	26.58
Sweden,[2]	1856–1860,	404,829	90,135	159,993	14.34	25.46
Norway,[3]	1856–1868,	677,967	72,651	127,635	10.71	18.82
Prussia,[4]	1852–54,	2,292,150	411,398	678,875	17.94	29.61
Austria,[5]	1860–61–65,	3,076,811	775,082	1,175,598	25.19	38.19
Bavaria,[6]	1857–62,	823,468	280,353	335,687	34.04	40.64
Netherlands,[7]	1850–59,	1,075,979	260,112	379,153	24.17	35.24
France,[8]	1857–62,	5,739,275	964,434	1,560,480	16.80	27.18
Italy,[9]	1868,	900,416	204,300	366,200	23.80	40.67
Spain,[10]	1858–62–65–68,	5,334,958	993,115	2,052,212	18.61	38.16

1 Annual Reports.
2 Officiela Statistik Helso och. Sjukvarden.
3 Officiela Statistik.
4 Preussische Statistische, 1862–3–4–9.
5 Statistische Jahrbuch, Oesteriche.
6 Statistik der Konig-Bayern.
7 Statistisch Jaarboek, Nederland.
8 Mouvement de la Population.
9 Statistica de Regno d'Italia, 1868.
10 Annuario Estadistico de Espana 1866–67.

Another method of comparison is the proportion of deaths to the living at the same age. This is stated in the English and Scotch reports, and may be calculated for others.

A less reliable ground of comparison, but none the less certain as evidence of early mortality, is the proportion of deaths that fall on any age to the total number of all ages.

The following table shows the proportion of the total deaths that fell on those under one and under five years :—

COUNTRY.	Ratio per cent. of all Ages.		COUNTRY.	Ratio per cent. of all Ages.	
	Under 1	Under 5		Under 1	Under 5
Massachusetts,[1] .	19.43	36.61	Norway,[4] . .	18.82	33.33
Kentucky,[1] . .	21.87	41.61	Prussia,[5] . .	21.25	47.52
So. Carolina,[1] .	23.31	45.59	Austria,[6] . .	30.39	49.96
Michigan,[1] . .	25.93	33.21	Holland,[7] . .	31.94	46.58
England,[1] . .	21.24	40.53	France,[8] . .	20.92	32.71
Scotland,[1] . .	19.35	37.96	Italy,[9] . .	27.72	47.26
Russia,[2] . .	–	52.60	Spain,[10] . .	18.61	38.46
Sweden,[3] . .	22.26	39.52			

[1] Annual Reports.
[2] Government Report.
[3] Officiela Statist. Helso.
[4] Officiela Statist.
[5] Preussische Statist.
[6] Statist. Jahrbuch.
[7] Statlst. Jaarboek,
[8] Mouvement de la Population.
[9] Statistica del Regno.
[10] Annuario Estadistico de Espana 1866 67.

Here are manifestly very different proportions. This difference may be, in part, due to the difference of the composition of the living population.

In a State just settled by immigrants a very large proportion of the people are youths and middle-aged, and comparatively few children, and still fewer infants and old people, and of course, in their mortality, there would be a correspondingly large proportion in middle life, and small in infancy and old age. Soon they marry, and in a few years the young children and infants form a large and the aged a small proportion of the population. Consequently the reports of deaths in the same period, show a large proportion of infants, a smaller proportion of the middle-aged, and very small of the very old. Nevertheless, in old and fixed populations, these differences indicate something more than the difference of the proportions of the living.

Whatever may be the explanation of the difference of the proportion of infants to total mortality, still the irresistible fact remains that from nearly one-fifth to nearly a third of all the deaths fall upon infants under one; and from a third to a half upon children under five; and the still more decided and indicative fact that from a seventh to one-fourth of all that are born, fail to pass their first year, and twenty-five to forty per cent. perish before they have completed their fifth year.

Reasons.

The first question that arises is, whether it is a necessary condition of human life that so many should perish in the outset. Are these proportions of children endowed originally with such feeble constitutions, that they cannot endure the burden of earthly life beyond the period of one or five years? Are they endowed with only sufficient living force to run the vital machine for these brief periods?

There is no doubt that with many it is so, that some children are born with low and imperfect organizations, and with constitutions too weak to sustain the process of development, and therefore more or less must fall by the way. This explains a part of this great proportion of infant mortality.

Premature Birth.

The security of infant as well as of adult life, depends primarily on its constitutional force, or power of performing its organic functions with vigor and comfort, even amidst the causes of disturbance and disease.

The primordial constitution depends on prenatal conditions which belong to or may be controlled by the parent. Life proceeds from life, like forms like. The parents can give only such as they have in themselves. The feeble, the scrofulous, the intemperate, those who are themselves vitiated or impaired by heritage, by disease and exhaustion, or by sensual indulgence, have no fulness of power to impart to their children. The parents who in any way waste or vitiate their own vital force, or unwittingly suffer it to be vitiated or reduced, do or suffer this for their offspring that afterward proceed from them. Their constitution, whatever it may be, is an entailed estate that must pass, with all its worth and incumbrances, to the

heirs of their own bodies. The misfortunes and sufferings as well as the iniquities of the fathers and mothers are visited upon their children, possibly, even to the third and fourth generation.

The conception and the prenatal being of the child are thus entrusted to the parent, and it requires for its full development and preparation for outward life and exposure, all the mother's care and devotion. If she fail to regard her new condition, and recognize her new responsibility, and adapt her habits of action, costume and diet to the wants of the prospective child; if she, from influence of fashion, desire of concealment or other motive, refuse to allow the child opportunity of expansion, or if she expend her forces in excessive labor or exposure, or dissipation of gay or vulgar society, or if she suffer from privations of proper food, or indulge in unsuitable diet, and thus impair her digestion, or embarrass her nutrition, she diminishes her power of giving her child the full development that can only be secured by a healthy and well ordered life in the parent.

All these conditions and habits as they occur in the parent, have their natural effect on the constitution of the child, and diminish its power to bear the exposure of the world, and to resist the causes of disease.

The first and immediate danger from any irregularity of the mother is premature birth, which sends the child abroad before it has completed the prenatal development that nature intends for her perfect children. Those who are thus born before their time are generally, almost universally, feeble, and imperfectly prepared for outward life.

In England, during the six years, 1858 to 1863, inclusive, among 626,340 children that died in their first year, 45,814 were prematurely born,* and had incomplete development, and therefore, were imperfectly prepared for the contact with the outward world. These constituted 7.31 per cent. of all the deaths of children, under one year old. In the ten years, 1861 to 1870, the deaths of 85,118 children, or 1.75 per cent. of the whole, are ascribed to this cause alone.†

* Supplement to the Reg.-Gen. 25th Report p. vi.

† Reg.-Gen. 24th to 33d Reports.

There is no record to show how many of the children were prematurely born in this period, but it is not to be supposed that they made any approach to the proportion. The premature children have a much harder struggle to live, than those that are born at full time, and a much larger proportion succumb before the trials that they encounter.

"At the Maternity Hospital in Paris, in 1869, there were 1,320 births at full time and 641 premature, 1,961 in all. 127 or 9.5 per cent. of these born at full time, and 332, or 51.8 per cent. of those prematurely born, died early. The proportion of mortality in the last was almost six times as great as in the class more completely developed and prepared for the chances and exposures of life." *

Difference of Constitutional Force.

In the question of mortality or liability to death, there is ever to be held in mind, both the power of the disease or the destructive agent, and the constitutional power of resistance.

A child inheriting a weak constitution or prematurely born, with constitution incompletely developed, or with constitutional force reduced by imperfect nutrition, exposure to cold or extreme heat, or by neglect, must yield before a smaller force of morbific agency than one born at full time, with constitutional powers completely developed and sustained by proper and successful care.

Healthy Districts.

Philosophical vital statisticians make several classes of districts, divided according to their sanitary conditions and vital results. Those that have the lowest rate of mortality, show at least the natural liability or capability of living, belonging to the human constitution in the best condition and under the most favorable circumstances. In table, on page 196, the lowest rates of mortality, as compared with the births, were 10.71 per cent. in the first year, and 18.82 per cent. under five, in Norway.

In Massachusetts, the mortality, under one, was 13.91 per cent., and under five, 25.62 per cent.

In Sweden, these proportions were severally 14.34 and 25.46 per cent.

* Beaugrand, Ann. Hyg. xxiv, 2d series.

They were 15.40 and 26.37 per cent. in England, and in Prussia 17.94 and 29.61 per cent.

On the other extreme, the deaths were 25.19 per cent. under one and 38.19 per cent. under five in Austria, including Hungary. They were 24.17 and 35.24 per cent. in Holland, and 23.80 and 40.67 per cent. in Italy, and the highest rates were 34.04 and 40.64 per cent. in Bavaria.

Thus we see, that the infant mortality was more than twice as great in Italy and Holland, two and a half times as great in Austria, and almost three and a half times as great in Bavaria, as it was in Norway; and the proportion of deaths of children, under five, was twice as large in Spain, Italy, Austria and Bavaria as it was in that colder but more healthy country of the Norwegians.

Thus, as often as 1,000 infants died in Norway, 1,298 died in Massachusetts, 1,338 in Sweden, 1,438 in England, 1,738 in Spain, 2,222 in Italy, 2,257 in Holland, 2,352 in Austria, 3,178 in Bavaria, among the same numbers born in each country.

It is not to be supposed that it is the primary intention of nature that the little children should perish so much more frequently in Bavaria, than in Norway or Massachusetts. The Norwegian rates of mortality, 10.71 per cent. under one, and 18.82 per cent. under five, are the lowest for infants and children that are found in the record of any nation. This, however, includes the whole country of Norway,—all its districts, healthy and unhealthy, all its people, discreet and indiscreet, favorably and unfavorably situated.

If a selection of districts, and people, and families could be made, and the experience of only the best included, there would be found a much lower rate of early death than these figures present for the whole nation.

Yet taking these rates of 10.71 per cent. under one and 18.82 per cent. under five, and admitting that so much is unavoidable, certainly in any large community it is worth while to inquire whether the excess that is found elsewhere, or even a part of that in Norway, may not be due to causes that are, in greater or less degree, subject to human control, and whether if guided by the best intelligence and under the

best moral discipline in those that have the care of infancy and childhood, the death-rate in these periods may not be reduced everywhere to the Norwegian standard.

From their exceedingly delicate sensibility, infants are susceptible of injury from manifold causes, either in the omission of what is necessary in appropriate food, in pure air, in temperature, in protection from cold, in the many attentions that tender and judicious nursing may give to develop the constitution or to sustain it during the progress of growth.

These morbific influences are found in various degrees and proportion in all countries and among all people. No one stands alone anywhere, but each may have a prominence and do most of the deadly work on those eeble lives.

Care of Infancy.

The most difficult task undertaken by man is the creation and development of life. Gardeners watch their tender germinating seeds and shooting plants with unfailing attention. They regulate all the influences that can bear upon them. They provide in due measure appropriate soil, nutriment, moisture, air and warmth, knowing that from any neglect of these matters the health of the feeble plant must suffer, and life may fail.

Farmers watch the young of their animals with assiduous solicitude; they inquire into every circumstance and determine its probable effect on the new life; they give the tender beings every favorable influence, and defend them from all that may harm them,—cold, rain, and improper food.

No other form of life, whether in the animal or plant, is so tender and so susceptible of injury as that of a child; it is the most delicate of all creatures, and demands the most exact obedience to the conditions of its being and the appropriate supply of its wants. It bears no neglect without suffering, no injudicious interference without injury.

Deaths in Early Weeks and Months.

This extreme tenderness is in the inverse ratio of the age of the child. The largest ratio of death is in the first week

and the first month. It gradually diminishes from the beginning of the child's days.

In France, the record shows that of 1,000,000 children born,—

29,123	die in the first week.		
22,128	"	"	second week.
22,236	"	"	sixteen following days.
73,487	die in the first month.*		

In England, according to the Life-Table, of 1,000,000 that are born,—†

46,503	die	in	the	first	month.
17,195	"		"	second	"
12,178	"		"	third	"
10,100	"		"	fourth	"
9,550	"		"	fifth	"
9,033	"		"	sixth	"
8,547	"		"	seventh	"
8,087	"		"	eighth	"
7,657	"		"	ninth	"
7,253	"		"	tenth	"
6,872	"		"	eleventh	"
6,518	"		"	twelfth	"
149,493	die in the first year.				

From these it appears that in France, one in 34 died in the first week, one in 44 in the second, and the same proportion in the next sixteen days, and one in 14 the first month.

In England, one in 21 died in the first month, one in 56 in the second, one in 77 in the third, and one in 131 in the twelfth.

With its exceedingly delicate susceptibilities, the infant demands every favorable condition of care, clothing, warmth,

* Reg. General England, Sup. to 25th Rep. p. vii., calculated from the French Reports.

† English Life-Table, p. xxiii.

air, food and circumstances. It wilts under every privation of any of these means of life, and sinks under any adverse influence, from whatever cause.

Diseases of Infancy and Childhood.

The diseases that destroy life in infancy and childhood are found in all countries and climates, yet in very different proportions. The following tables show the ratios of deaths from each cause or class of causes, of children in the United States, Massachusetts and England :—

Showing the Proportion of Deaths from each Cause, or Class of Causes, to all Deaths under five, in the United States and Massachusetts.

CAUSES.	MASSACHUSETTS.* Both Sexes— 1870.	UNITED STATES.† Males— 1859-60.
ALL CAUSES,	10,000	–
Disease of Brain,	138	214
Bronchitis,	102	70
Cephalitis,	355	474
Cholera Infantum,	1,740	327
Consumption,	323	255
Convulsions,	480	523
Croup,	414	942
Debility,	195	52
Diarrhœa,	257	412
Diphtheria,	157	52
Dysentery,	288	489
Enteritis,	94	202
Typhus Fever,	134	164
Hydrocephalus,	457	207
Canker,	133	–
Measles,	203	184
Infantile,	476	427
Pneumonia,	685	739
Premature Births,	252	–
Scarlet Fever,	714	1,075
Tabes Mesenterica,	274	44
Teething,	292	322
Whooping-cough,	327	447
Burns,	55	–
Casualty,	25	450
Lung Diseases,	29	113
Scrofula,	55	83

* Annual Report. † Census, 1860. Mortality Vol.

*Showing the Proportion of Deaths from each Cause, or Class of Causes, under one year in England.**

CAUSES.	Males.	Females.
ALL CAUSES,	1,000,000	1,000,000
Disease of Brain,	223,209	208,015
Disease of Lungs,	146,561	137,218
Cholera, Diarrhœa, Dysentery,	90,218	93,619
Other zymotic diseases,	39,431	43,118
Whooping-cough,	33,174	45,068
Hydrocephalus,	27,794	24,587
Disease Stomach and Liver,	23,490	19,810
Scrofula, Tabes Mesenterica,	23,373	23,865
Measles,	13,669	14,446
Phthisis,	12,548	13,975
Scarlet Fever,	11,252	11,299
Violence,	10,488	12,109
Small-pox,	9,773	11,201
Typhus Fever,	5,762	6,010
Heart Disease and Dropsy,	4,151	4,481
Disease of Skin,	2,829	3,225
Diphtheria,	1,931	1,798
Disease of Kidneys,	376	272
Disease of Joints,	316	446
Cancer,	154	209
Disease of Generative Organs,	79	59
Other Causes,	318,768	324,905

Thus it is seen that diseases of the digestive organs caused more than one-quarter of the deaths, under five, in Massachusetts, and about one-ninth, in England. Diseases of the brain and nervous system, including dropsy and convulsions, destroyed about one-seventh in Massachusetts, and one-fourth in England. Disturbances connected with the lungs and respiratory organs, including croup and whooping-cough, caused nearly one-fifth of the deaths of children in both countries.

These are the leading causes of death in infancy and childhood, in all nations, but differing in their proportions.

Both in Massachusetts and in England the reports include a considerable number of deaths, mostly in infancy, under the causes termed "Debility," "Atrophy and Debility," "Inanition," "Premature Birth," all resting upon imperfections of

* Calculated from Table in Supplement to Reg. Gen., 25th Rep., p. 2.

constitutional development or force, and inability to digest food and obtain from it sufficient nutriment for the body.

Food and Nutrition.

The prominent wants of the infant are food, warmth and air.

The first is provided by nature in the mother's milk, which is exactly adapted to the feeble and tender digestive organs of the child, and changes in its character with the necessities and capacities of the new-born consumer.

No other aliment can take the place of the human milk. The milk of other animals,—cows, goats, etc., are not so well adapted to the powers and wants of infants. Their stomachs find great difficulty in digesting it, and their assimilative organs often are unable to extract from it sufficient aliment to supply the wants of the textures.

The nurse-bottle, which is used, too frequently for the child's good, from seeming or actual necessity, is filled sometimes with contents less acceptable and more injurious to the infant's stomach—gruel, chicken-broth, pap of manifold kinds. Beaugrand, in his article on the early death of the new-born, calls the nurse-bottle deadly, "*funeste*," and shows how the children that are fed by it sometimes die from inanition, as it is termed, from want of power to convert the food into flesh. Whether the child has nothing to eat, or has its stomach filled with food which it cannot digest, or of which the nutrient arteries cannot make flesh, it is all the same to the child; it is actually starved for want of nourishment in the textures, the place where it is needed.

Mother's Temporary Absence.

The infant not only needs the mother's milk, but wants it frequently. The fountain should never be long absent.

The nursing children of those mothers whose labor or business or pleasure require their protracted absence from home, suffer much from hunger and defective nutrition. Some pine away, and some at length sink into death. Among the poor there are some who are called from their homes, to work abroad during the day. They are with their babies and can nurse them only in the morning, before they go to their

work abroad, at noon when they return to their own dinner, and at night after their day's labor is finished. And some even are absent through the whole day. The infants are thus left to be fed at home by cow's milk, goat's milk, farinaceous food and other unnatural and unsuitable means.

This is common in England, where women work on the farms, often distant from their homes, and in the factories. Dr. Husband says :—

"In some of the agricultural districts of England we find a very high rate of infant mortality. The medical officers of health, after investigating the subject, found that the cause of the excess was the employment of female labor. The mothers are employed at out-of-door work, and their children are left in the hands of bad nurses, or children not much better.

"It is found that in certain families, child after child is born, which as regularly dies, and the neighbors know as well as may be, that the child terminates its existence, not through accidental death, but from carelessness and deprivation of food." *

Beaugrand says, that in the neighborhood of great manufacturing establishments, in France, the children of the female operatives perish in their early weeks or months of life from this cause. The mothers in their straitened circumstances, feel obliged to contribute as much as possible to the support of their families, by working in the mill. So they get back to the factory as soon as possible, after their confinement; consequently, the sickness and mortality of the infants of these mothers are increased. This was manifested in many industrial centres. In Manchester, England, the death-rate of these children of the operatives rose to 22 to 23 per cent., and in Mulhouse, a large manufacturing town of France, it rose as high as 30 even 38 per cent. This attracted the attention of Mr. Dolfus, the wealthy proprietor of one of the establishments, whose wisdom and success were only equalled by his thoughtful benevolence. He then ordered that every one of his female operatives, who should be confined, should remain at home and attend to her child, for six weeks, after it was born; but that her wages should be paid the same as if she were at work. This was the first of November, 1862. There were then 1,050 women employed in his factory; one hundred and eight of these were confined

* Social Science Transactions, 1854, page 506.

within the next year, and twenty-five of the children died. This was but two-thirds of the proportion of the previous year's mortality. In the next year, the mortality was still farther reduced.

Mr. Dolfus was so well satisfied with the result of his humane plan, that he proposed to other manufacturers, who employed married women, to adopt it as a permanent rule for their establishments.

Dr. Beaugrand adds, in his admirable article, in the Annales de l'Hygiene, 1866—"We proclaim these facts abroad, in trust that all establishments may follow the example of these manufacturers of Mulhouse, who have already ameliorated so greatly the condition of their working-women."

To meet this difficulty, establishments called *creches* have been opened in Paris, London, Manchester and other places, where mothers can deposit their little children, while they are at work away from their homes during the day. Here doubtless these infants are taken care of, as well as possible, in the circumstances. But they are deprived of their natural food, and have a lower chance of health and life, than if they were not separated from their mothers. Dr. Husband adds, "This is after all a very poor substitute for the care and attention of the mother, and a very inadequate provision for the comfort of the child, but no doubt it saves many an infant life." *

The necessities of infant nutrition are the same in all ranks of life, and the child suffers from the want of sufficient and appropriate food, at short intervals, in its early and feeble being. Whenever the mother is kept away, from whatever cause, whether by the necessities of earning bread for herself and her other children, or by the calls of society, or the simple power of ignorance or indifference, the child hungers and is weakened, and sometimes takes the steps that lead to death. The necessity of appropriate nutrition with the mother's milk, and at due times, admits of no relaxation, and cannot bear neglect without injury to the child, through the early months, even to a year or more.

The English and Irish reports include a considerable

* Social Science Transactions, 1864, page 509.

number that died for "want of breast-milk." Dr. Husband says this privation leads to debility, inanition, difficult teething and general impairment of health, and consequent inability to resist attacks of disease. And many a child, that was robust as long as it had the natural food, withered away when it was put upon an artificial diet, and finally sank under a mild attack of diarrhœa.

The French statistics show that in one part of France "when children are given to wet-nurses and have the human milk, though not the mother's, the mortality is 37.1 per cent. But in the class of children that are brought up by hand on cow's and goat's milk, or other food, through the nurse-bottle or the spoon, the mortality rises to 63.9 per cent." This difference is noticed in the neighborhood of Paris, to which many of the children are sent from the maternity and foundling hospitals of the city.

Effect of Food on Milk.

It is well known to farmers, especially to those who are milk-producers, that the milk is very materially affected by the food they give to their cows. If they eat onions, the milk has a taste of garlic. Turnips impart a peculiar and unpleasant flavor, and sometimes the cattle eat noxious herbs in the pastures, which are discovered only by the offensive state of the milk.

Distillery-Milk.

A few years ago, there was a great complaint of the milk in New York, which was supplied to the market from cows that were kept at the distilleries and fed upon the waste vegetable matter, the residuum of the process of distillation. The sanitary authorities caused the milk to be chemically examined, and they watched its effect upon the children and adults who drank it. The milk was found to be bad. It was different in elementary character from that produced by cows that were fed upon grass, hay or grain. It was not so well digested in the stomach, nor had it the nutritive power to create flesh and sustain strength. The children lost flesh or failed to gain it. Their skins were pallid, sometimes discolored and corrugated. Their countenances had the appear-

ance of old age, rather than the bright and lively bloom of childhood. They suffered from diarrhœa and dysentery and great debility, and many died.

The French have had this matter under consideration; for they found that although the distillery-fed cows had a great flow of milk and were profitable to the owners, yet the children that drank it suffered a great deal from waste of flesh and strength, and the loss of infant-life was great.

Some years ago, several persons in Malta were poisoned. On investigation, it was found that they had drank the milk of goats that had eaten of the Euphorbia Helioscopia, a poisonous plant that grows in the pastures of that island. The characteristic poison was imparted to the milk, and through this it was given to the consumer.

The same relation of diet to milk holds with woman as well as with domestic animals. As the nurse feeds herself, so is the food she offers from her body to the infant that is nourished by her. Those who are meagrely and improperly fed offer meagre and unfitting food to their nurslings. Women who drink beer, porter or spirit for appetite, or with the honest intention to increase the milky secretion, run the risk of providing a vitiated nutriment for their infants.

Even the morbid condition of the mother may be conveyed through her milk to the child. A physician in Massachusetts being called to a nursing-child, suffering from diarrhœa, was informed by the mother that she had the same trouble, and also that she had eaten green corn, which usually had this effect upon her. The physician did nothing for the child, but directed the suspension of this food. The disturbance ceased at once with both. But the mother being very fond of this diet ventured again twice, and at both times the same effect followed in both mother and child, and in both ceased on the suspension of the corn.

Even the medication of the mother is felt also by the child. In July, 1872, there was in Roxbury an infant fatally narcotized through the mother. Suffering from great distress, she consulted her physician, who gave her fifteen grains of chloral hydrate and one-fourth of a grain of sulphate of morphine. In three-quarters of an hour after taking this medicine, she nursed the child, which to all appearance was perfectly well

at the time. But soon afterwards he went to sleep, and manifested the usual effects of narcotism, and died in about twelve hours. Although strict inquiry was made, no cause of poisoning could be discovered except through the milk taken from the mother.*

Purgatives taken by the nurse sometimes act also on the child.

It is manifest that the character of the milk and the health of the child depend very materially on the manner of the mother's self-management, and that much of the ill-health of nursing-children and some of their mortality are connected with the errors in the maternal digestion. Among the poor, who have no choice of food, but must take such as their limited means allow; among the ignorant, who consider, if they think at all, that the stomach is indifferent as to the matters that are put into it, and will digest all alike; among the sensual and self-indulgent, whose appetites or caprices are their ruling motives in selection of food, it is easy to suppose that some will occasionally, more probably very frequently, err in diet. They fail to nourish themselves as they should, and to produce in their own persons the nutriment best suited for the health of their babes. Their children therefore are often badly nourished, they suffer from inanition and debility, and from disorders of the digestive-system, which may end in death.

The deaths from diseases of the digestive organs among children under five in Massachusetts were over 7,900 in the last three reported years, and in England, over 80,000 under one and over 115,000 under five, in the years 1867 to 1870.

These numbers show that the nutritive system is exceedingly susceptible of disturbance, and while it is the absolutely needful agent in the maintenance of life it may become, under improper management, as from other causes, a frequent agent of death.

The Poor.

The poverty of the poor, as a class, reaches beyond their outward pecuniary condition. They have a small portion of the world's goods, and as a consequence, in a very large pro-

* Boston Medical and Surgical Journal, LXXXVII. 116.

portion of cases, and as a cause of this fact, in many others, they have a lower bodily health and shorter duration of life.

They are compelled to engage in the hardest and most dangerous labors. They suffer more from exposure and from accident. They have less means of sustenance for themselves and their families. Their houses are necessarily cheap, often in the less desirable and healthy places. They live often in wet and unwholesome localities in the country, and in the narrow and crowded streets of cities. They can have but small space around and in the house for themselves. They can have but few rooms, some have but three, others have but two, and many have but a single room for the whole family of father, mother and children. In these, or in this, they do all their domestic work. Here they cook and eat, they wash, dress and sleep, and here they are sick and here they die. Their narrow quarters are filled with the fumes of the cooking processes, sometimes with the smoke of the fire, and often with tobacco-smoke of the self-indulgent father and his visitors. Add to these the emanations from the lungs and the skins of the family, and it is manifest that the air they breathe is corrupted and overloaded, and there is but small opportunity for the dwellers to purify their blood with a good supply of oxygen.

The air of such crowded rooms becomes loaded with an intensely oppressive odor, that attaches itself to the persons and clothing of those who live in them, and is carried abroad through long distances of travel in the open air. There is little opportunity for ventilation, or even motive, for the air abroad, that would first enter their room, is also foul and unhealthy.

The surroundings of these tenements of the poor are often no better than their inward condition; offal is thrown out, filth accumulates, and sends forth its effluvia to poison the air above it.

In the city, their streets are narrow, and the yards of their houses still narrower, and frequently wanting. Their rooms or tenements, both in city and country, are frequently cold. They are sometimes old houses, deserted by the more favored previous occupants, as unfit to be inhabited. Some are new

but badly constructed, and built with as little cost as possible, to accommodate the narrow circumstances of the poor.

Their clothing and other means of personal protection are equally uncertain, and often inadequate for their comfort or their health.

In the market they must consult their finances rather than their digestive powers or their wants of nutrition. They therefore buy the cheaper rather than the most nutritious food, and the cookery is often as imperfect as the material which they prepare.

So all the means that they have of sustaining and of protecting life—the air they breathe, the food they eat, and the shelter and clothing that protect them from the elements are of a lower character than the more favored are able to obtain.

Hence their life and strength are less developed and sustained. They have more sickness and less power to resist its ravages, and they sink earlier beneath its force.

Dr. Marc D'Espine, the celebrated and learned Swiss writer on mortality, says :—

> "Wealth and comfortable circumstances increase vitality and longevity. They raise the mean or average of life. They lessen the mortality at all ages, and especially in infancy. But poverty and misery have the contrary effect." *

The children, especially the infants, with the extreme delicacy of organization and great susceptibility of influence, particularly for evils belonging to their years, feel the force of all these depressing conditions and circumstances more than the adults.

The hard necessities and the severe labors of the mother often prevent her from giving the prenatal child opportunity of development, and after birth she cannot give the little nursling the attention that is needed for the establishment of its physical constitution on the best basis for endurance. Moreover with the ignorance and uncertain discipline of the parents and household, the child is submitted to regimen as to diet, clothing, air and exercise unsuited to its wants and powers, and frequently injurious to its health.

* Annales de L'Hygiene, xxxvii. 325.

Dr. Fraser says, in respect to a district of Glasgow, under his inspection :—

"Within no very limited area, none of the children that I saw were well, and I found that more than one-half of the whole, born alive, had died very young. One woman had five living children, but had lost six. In another family three survived and seven had died."

"It is no uncommon thing to find in families having originally seven, nine, eleven and even thirteen children, one or two only reaching adult-life. Fearful as this is it is to be found in nearly every considerable city in the kingdom." *

The records of sickness and mortality confirm these deductions, which are drawn from seeing the condition and habits of the poor. Mr. Chadwick, in his report on the sanitary condition of the laboring classes, page 161, says, that he found in fourteen cities and districts that the average age, at death, of 1,232 members of the most comfortable classes including the children and infants was 44 years. Of 5,035 persons in families less comfortably circumstanced, it was 27.47 years, and 20,385 persons in families of the poor had enjoyed an average life of only 19.58 years. The average longevity in the most favored class exceeded that in the poorest by 125 per cent.

The difference was most in the deaths of the children. Compared with the number living under one year, the deaths were 20 per cent. in the best, 44.4 per cent in the middle class, and 50 per cent. in the poorest.

The experience of Paris gives a similar result. Villermie says, that in three arrondissments, where only 7 to 11 per cent. were exempt from tax on account of poverty, the deaths of infants, at their homes, were only one in sixty-four of the living, while in other districts, in which 31 to 33 per cent. could pay no tax, the deaths, were one in forty-five.

The deaths of infants at home and in hospitals were one in forty-three living in the richer, and one in twenty-six in the poorer districts.

There are no records in this country that show the mortality of the comfortable and the poorer classes separately. But in Massachusetts and in Boston, the births and deaths in the American and foreign families are separately recorded.

* Trans. Social Science, 1860, page 650.

The record of the American families include all the native poor as well as the prosperous. But a much larger proportion of the foreigners are poor.

In Boston, during ten years, 1862 to 1871, there were born 20,867 children of American and 42,582 of foreign fathers. In the same time, the deaths were 3,438 under one year, and 5,428 under five years, of the first class, and 7,719 under one year, and 13,943 under five years, of the second class.*

Of those that were born in American families, 16.47 per cent. died under one, and 26 per cent. under five years. Of those born in foreign families, 18.13 per cent. died under one, and 32.79 per cent. under five years.*

The mortality of the foreigners' children was 10 per cent. greater under one, and 26 per cent. greater under five than that of children of natives.*

In Massachusetts, in the four years, 1867 to 1870, of the children born of both foreign parents, the ratio of deaths under one year exceeded that of the children of Americans by 10 per cent., and under five years by 28 per cent.*

In this connection the comparative ratio of infants and children to those of all ages buried in the Mount Auburn and the Catholic cemeteries in the vicinity of Boston agree with these deductions. During the periods examined there were of all ages, 19,735 buried in the Catholic cemeteries, of whom 5,688 or 28.7 per cent. were under one, and 11,486 or 58.2 per cent. under five. At Mount Auburn 16,949 were buried, of whom 1,973 or 11.6 per cent. were under one, and 4,771 or 28.1 per cent under five.†

The Catholic families are immigrants, and therefore have a very small proportion beyond middle age. But they have a much larger proportion of young children than the families whose members are buried at Mount Auburn, but the proportion of this excess of their living is much less than is shown of their dead children.

Records of the mortality of Concord, Mass., for sixty-five years, and of Dorchester, for seventeen years, show the occupation and social positions, as well as the age of the deceased.

* Annual Mortality Reports.

† Condensed and calculated from the records of the cemeteries.

The proportion of deaths under two years in the families of the farmers that owned their farms, was 11.94 per cent. of those of all ages, and in the laborers' families the proportion was about double, or 23.5 per cent. In order that the farmer should own his farm, it is necessary that his wife, who is his partner and coöperator, should be wise, discreet and thrifty. This wisdom and discretion, which she brings to the management of the general affairs, is shown in the care of her children, and this is the result.

Education and Ignorance.

The infant's life is in the care of the mother, and its safety depends upon the intelligence and discretion that she can give to this responsibility. There is no record that discriminates between the intelligent and the ignorant of the mothers, showing the number of each class. Nor is there any record of the deaths of the infants of these educated and uneducated parents. But there is an approximation to these facts on a large scale in the registration reports of England.

In England every person when married is recorded, and required to sign the register; and if unable to write, the groom and bride must make the mark.

The reports show the numbers and proportions of both grooms and brides in each district, who wrote their names or made their marks.

The same records show the births and the deaths at each age. For the purpose of showing the connection between the education of the parents and the life of their children, the records of twenty-five years, including 3,362,742 marriages, have been analyzed, and divided into several classes, according to the proportions of the brides who wrote their names in the register.

In the most intelligent class, there were 648,260 marriages, and 20 to 30 per cent. of the women made their mark. In the least intelligent class, there were 661,929 marriages, and 60 to 70 per cent. of the brides made their mark. In the first class there were 2,231,959 children born, and 327,040, or 14.65 per cent., died under one year old. In the last class 1,776,547 children were born, and 439,359, or 24.87 per cent., died before they passed their first year. As often as 1,000

died in their first year, in the more intelligent class, 1,698 died in the least intelligent class among the same number born in each.

These classes are both large; each includes city and country, commercial, mining, manufacturing and agricultural districts. The only difference apparent is the diverse proportion of the mothers who could write their names.

It is not to be supposed here, that the simple fact of inability to write caused the death of infants. But this inability to write is a representative fact. It represents a want of education and intelligence, a lower degree of discipline and thrift; with these mental and moral conditions are associated more poverty, and even destitution, the more frequent want of means of support and the comforts of infant life, a more careless and indiscreet management, more intemperance, and neglect of children. In the best class 20 to 30 per cent. could not write, and in the worst class 30 to 40 per cent. had this accomplishment, but if these could be excluded, and none but the educated be in the first, and none but the ignorant in the last class, the difference in the chances of infant-life would be found to be much greater.

Overlaid—Suffocation.

A cause of death of infants is found in the British and Irish reports, termed *overlaid*, or smothered by the parent or nurse in bed. The reports of England show that in the eight years, 1863 to 1870, 1,125 were destroyed in this manner; this is 140 a year. But perhaps these are not all. In these eight years, there were 7,580 deaths from suffocation; 5,588 of these were children under one year, 1,125 were overlaid, and 3,606 were said to be "*suffocated by bedclothes.*"

How many of the last were overlaid is not known. But from evidence given in a discussion of this matter, at a meeting of the Social Science Association, 1864, it may be feared, that many more infants were overlaid and put to death by their parents than these figures indicate. Dr. Lankester, the learned and scientific coroner of London, said, "I find that in one year I held inquests on ninety children who have been suffocated in bed." Mr. Raper said, "It appears that seventy-two cases of deaths of infants that had occurred from suffoca-

tion between Saturday and Monday, were brought before the coroners' courts of Liverpool."

Dr. French: "The parents having been paid their wages Saturday, get drunk and neglect their children." Dr. Raper: "The great bulk of these, nearly the whole, occur through the drunkenness of their parents. The beer-bill created 8,000 beer-shops in Lancashire." "The removal of that law would remove the temptation to that vice, that produces a great deal of our infant mortality." Dr. Lankester: "A large number of these children are found dead on Sunday morning, and, I fear, many of them are caused by the Saturday-night orgies. Drunkenness is the frequent and fruitful cause of infant mortality." *

The term *overlaid* does not appear in the mortality reports of other countries. But suffocation is given as the cause of ninety-two deaths of all ages, of whom sixty-three were under five, in Massachusetts, within the five years ending with 1870. The last census of the United States reports 1,255 deaths from this cause, in the year 1870–71, of which 931 were of infants under one, and 1,023 were under two. In the "Southern Medical Reports" printed in New Orleans, about twenty-five years ago, Thomas Affleck, Esq., of Washington, Mississippi, in an article on the hygiene of cotton-plantations states, that "the mortality of negro children is two to one when compared with the whites;" "not a few are overlaid by the wearied mother, who sleeps so dead a sleep as not to be aware of the injury to her infant." This finds some corroboration from the mortality report of the last census. In the year 1869–70, in eight Southern States, with a population of 7,222,409, of whom 3,271,321, or 45.3 per cent. of all, were colored, there were 552 deaths from suffocation; 479, or 86 per cent. of these, were of children under one year. In ten Northern States, with 17,622,493 inhabitants, of whom 306,254, or 1.7 per cent., were colored, there were 406 destroyed by suffocation; 228, or 56 per cent., were under one. Most of the others were adults suffocated in mines by charcoal fumes, etc.

In the States where the colored population forms a large proportion of the whole, the deaths from suffocation were

* Transactions, 1864, p. 651.

one in 13,084 living, and the babes were 86 per cent. of the whole. In the other States, with a very small proportion of colored people, the deaths from this cause were one in 48,405, and the infants were only 56 per cent. of the victims.

Illegitimacy.

Quetelet, speaking of illegitimate children in his work, Sur l'Homme, p. 231, says, "The deadly heritage of vice attends the infant before birth, and pursues him for a long time afterwards."

The depressing circumstances, conditions and influences that sometimes attend and impair the life of children born in wedlock, are more intensified and destructive, and hover more frequently about those who have no legitimate fathers.

The mother, oppressed with shame and sorrow, endeavors to conceal her state, by all the means of dress and compression. Practically denying her condition she can ask no favor of family or society, but assumes and bears the burdens and labors that are assigned to the healthy and unencumbered. The child is deprived of the requisite opportunity of development and growth. Means are often used for its premature removal, and result in its injury, and when at length it is born, its constitution is generally lower than that which belongs to the children of honest parentage.

As soon as the unwelcome child is born, its exceedingly feeble life is surrounded with foes on every side, and finds few friends to protect and sustain it. An object of fear and anxiety to the mother, who is allowed but little or no opportunity to attend to its wants and caress it, an object of aversion and even of disgust to the family and associates, there are few or none to offer their tender and affectionate attentions to this frail waif of humanity, and make its differcult path to strength as easy and sure as to other children. Family, friends and society, or the inexorable force of circumstances, deny the claim of the child upon its mother for parental care. But they demand of her that she shall bear her part of the burden of the world and work with her hands, as if she had no maternal love and no object to expend it upon.

Most frequently society recognizes in this forlorn, deserted woman, no other attribute of motherhood than the fountain

of nutriment which nature has provided in her person for her own offspring. But even this she feels compelled to sell, with all her power of motherly sympathy and attention, in order to obtain bread for herself and her babe. Thus the well-born child of affection and honor drinks the milk and enjoys the exclusive watchfulness that naturally belongs to another, while the base-born child of infamy and sorrow is deprived of its only heritage of good; it is made an outcast, and sent to live with hirelings. Although these strangers have no motive but gain, they are poorly paid for their responsibility. They have neither the intelligence nor the heart, still less the time to give that which the infant most needs,—a mother's judicious and affectionate care. They may feed it with the natural food, but generally with the milk of animals and diet less digestible and less fitted to sustain its life and health. The child's feeble constitution has a hard struggle with these unfavorable conditions and circumstances, and often sinks beneath their weight.

In Prussia, during fourteen years, while 17 per cent. of the legitimate infants died in their first year, 25 per cent. of the illegitimate died at the same age. In Berlin, 19.8 per cent. of the first class, and 36.2 per cent. of the other died in infancy. In Stettin, in the five years, 1854 to 1858, these proportions were 22.3 and 45.1 per cent. respectively.

In Bavaria, through five years there were born in wedlock 633,119, and out of wedlock 190,349 children. The deaths in the first year were: legitimates 207,750, or 32.8 per cent.; illegitimates, 72,663, or 38.29 per cent.*

In Austria in 1861, 1862 and 1865, and in Hungary in 1865, the births were:†—

Legitimate, ...	2,705,536
Illegitimate, ...	371,275

Deaths under one:—

Legitimate, ...	645,663, or 23.86 per cent.
Illegitimate, ...	129,419, or 34.85 per cent.

Quetelet, quoting from Sussmilche, says "that for every ten of the legitimate that die in each of these several periods,

* Statistiche Konig Bayern, 1861.

† Oesteriche Jaarbuch, condensed.

there are deaths of the illegitimate in the first month, twenty to forty; in the second and third months, twenty; in the fourth to sixth months, seventeen; in the seventh to twelfth months, fifteen, out of the same numbers born in each class."*

The reports of France and other nations tell the same story, showing the universal law, that infants born out of wedlock suffer the necessary consequences of neglect, the frequent privation of maternal care and appropriate food. They have therefore a lower vitality, and a larger proportion of them die in infancy and childhood, than among those that are allowed to enjoy the tender, faithful care and appropriate food that nature intends for her little children.

Foundlings—Abandoned Children.

Beneath the low depths of wickedness and suffering just described, there is a still lower depth connected with the children,—those that are abandoned by their mothers and left in the street to take their chance of death, or of being rescued by the pity of strangers, or sent to the foundling-hospitals with a somewhat better chance of life. This is usually the last act in the long process of concealment practised by the mother whose condition and suffering have been known only to herself and one or more confidants.

Some of these infants have been the subjects of attempts to procure abortion. From all these causes these children come to the world, with the lowest vital force, the smallest hope of continued life. Then they are rarely fed,—almost never properly,—as they are hurried away before the natural nourishment is provided. To prevent the crying that might lead to discovery at home or on the way from the place of birth to the stranger's doorsteps or to the foundling-hospital, the child is often stupefied with opium. On the way to either, or while waiting in the street, if left there, the little spark of life suffers another cause of extinguishment, from exposure to the air to which it is unused, and to cold which it cannot resist.

However discreet and kind the people may be into whose hands the child may fall when left at their door, they are not

* Sur l'Homme, 231.

prepared for such a responsibility; they cannot meet its necessities, they are not nurses, they have not the natural food. Through the transition from its first resting-place, through the police, the station-house, to the asylum, if such there be, to the almshouse, or possibly to some charitable heart, that is willing to receive, and even adopt it, the infant finds no strengthening, but is subject to continual exhaustion, and when it arrives at its destination, its life is very low, and gives but little promise of continuance.

With such children nothing but the best appliances will avail. More than others they need the human milk, yet few can be indulged with it, and even they, with rare exceptions, can have only a part, a small part, of their nourishment from this source. Their main dependence must be on the bottle-nursing. But the best care, protection, warmth and food are necessary, and even these sadly fail in a large proportion of these waifs. In the best institutions, even in the Massachusetts Infant Asylum, managed with the best charity and wisdom of the State, provided with the tenderest and most discreet attendance, with airy, properly warmed and ventilated rooms, with clothing most suitable and food most digestible and nutritious that can be obtained, including wet-nursing as part of the nutriment, with all these means of sustaining life, 48 per cent. have died in its four years' operation. The New York City Foundling-Hospital was opened in November 1869; in the first year 1,480 infants were admitted, and 826, or 55 per cent., died within that period.*

In almshouses, that have no especial provision for the care of these feeble children, where the extreme tenuity of their thread of life is not understood, and especially where economy is the ruling principle, the rate of infant mortality is much greater.

Foundling-hospitals are plentiful in Europe. They have received multitudes of abandoned children. And the general history of their operations shows how small is the vital force of those committed to their care, and how few of them can be saved.

In Rome, the mortality was 57 per cent.

* Rep. Board of Health, 1870, p. 279.

Sir James Simpson, in his lecture on health, before the Social Science Association, in 1867, said, "I mention the frightful mortality in foundling-hospitals, where all the laws of health are set at defiance. In the old Dublin Foundling-Hospital, of the last century, only some 135 lived out of 12,000 infants admitted." *

This, however, has been improved, for out of 52,000 admitted in thirty years, 1795 to 1826, only 41,000 died.†

Effect of Cold.

Children need fresh air for respiration, but little infants suffer from cold. "It is the custom in France to carry infants, within a few days of their birth, to the office of the mayor of the town, in order that the birth may be registered and the child become possessed of its civil rights." This is done through all seasons. The proportion of death within a limited period after birth was much greater in winter than in summer. "It was greater in the northern than in the southern parts of France." "It was greater in the sparse districts, where the children were carried long distances, than in the densely peopled places." ‡

In Russia, the deaths of children varied from 31.6 in the warmest provinces to 69.1 per cent. in the coldest. These differences follow the isothermal lines rather than latitudes. Wherever, from geographical structure, mountains and valleys, exposure to or protection from winds, the climate was colder or warmer, the same variation of infants' life and death was manifested; the cold air destroyed, the warm air saved many.

Here, however, we are met with the fact, that in Norway was the lowest rate of death within one year after birth. This is to be explained by the domestic character of the Norwegian mothers. They are mostly wives of farmers, discreet and faithful to their responsibilities in the care of their households, and especially of their children.

The constitution of children is strengthened by exercise in the open air, under proper conditions of protection, yet the

* Trans. 1867, p. 122.
† Porter's Progress of the Nation, III., 288.
‡ Edwards' Influence of Physical Agents on Life, 216.

plan of hardening, which some attempt, is destructive. It destroys the weak and weakens the strong.

Country and City.

It seems to be a universal law that condensation of population lessens the chances of life. The ratio of mortality is greater in city than in country, and this increases as the people live nearer together in the city.

The supplement to the English Registrar-General's twenty-fifth report, pages xxxviii to lviii, gives a table showing the number of deaths in 10,000 living, and average number of people to an acre of land, in each of the six hundred and twenty-three districts of England and Wales.

In the districts which had 100 to 250 persons to the acre, the annual deaths were 262 in 10,000 living.

In those which had one to two acres for each inhabitant, the deaths were 214 in 10,000.

In the thinly settled districts, with twelve or more acres for each, the deaths were only 168 in 10,000.

In the cities the mortality increased with the crowding of the living, as shown by the reports of deaths in the four places below.

TOWN.	Living to Square Mile.	Annual deaths in 10,000 living.
London,	50,000	251
Leeds,	87,256	272
Manchester,	100,000	337
Liverpool,	138,000	348

The excess of mortality falls in greater proportion on childhood than on maturity.

The deaths in the healthiest districts were 10,604 in 100,000 children under one year.

In Westmoreland and North Wales they were 11,884.

In fourteen city districts, 25,858.

In Liverpool, 28,005.

The annual deaths under five in the period, 1849 to 1853, were, in thirty cities, 338,990, and in healthy country districts 135,478, in the same population in each. As often as 100 died in the healthy country, 250 died in the city, among the same number living.*

The life-table, founded upon the most rigid observations, makes the proportions of deaths of children to be 5.29 per cent. for the country and 13.34 in the city, or as 100 to 252.

The reports of births and deaths of Scotland make three divisions of the people.

1. Those living on the islands.
2. Those living in the country of the mainland.
3. Those living in the great cities.

During the fourteen years reported, the proportions of deaths of children, for every hundred births in each class, were—

	Under one.	Under five.
Islands, ...	8.05	15.58
Mainland country, ...	9.80	18.26
Cities, ...	14.91	30.90

As often as 1,000 died on the islands, 1,217 died on the mainland country, and 1,852 in the cities, under one; and 1,172 in the rural, and 1,983 in city districts, under five.

There are similar differences in France. The deaths in 1861 to 1865 were less than twelve per cent. in two departments; less than fifteen per cent. in six; less than seventeen per cent. in nine departments, and 39.07 per cent. in Paris, in the same number living under one year.†

A chart recently published by Bertilon, shows the different rates of mortality of children under one and under five in each department, by the varied shading from perfect white, for the healthiest, to perfect black, for the most unhealthy.

* Reg. Gen. Sup., XXV. Rep., p. xxvii.

† Mouvement de la Population, 1861–1865, p. lxvii.

It is a little noticeable that the department of the Seine, in which is Paris, is not the blackest, but it is somewhat lighter, and its rate of infant mortality is 268.6 in 1,000; while seven of the neighboring departments are black, with rates of 277 to 359 in 1,000. The explanation is easy. It is the custom of the officials of the maternity and foundling hospitals of Paris, to send a large part of the infants to the country to be cared for, and their frequent deaths swell the rates of infant mortality in these districts, while that of the city is thereby diminished. Nevertheless, even these have a better chance of life in the country than they would have in Paris.

In 1863 the public administration of charities in Paris had charge of 22,829 infants; 17,759 of these were sent into the country, and there 1,359, or 7.65 per cent., died; 4,397 were retained in the city, and there 469, or 10.6 per cent., died.

Dr. Berg, the chief of the Royal Statistical Bureau of Sweden, says: "The difference between the towns, especially the large towns, and the rural districts has an important effect on the mortality of children of that country."

Dr. Herz makes the same report of Austria. And the records of mortality of other European nations give similar accounts.*

"In the least unhealthy rural districts of England, the death-rates of children, in their first year, are not more than one in twelve or fourteen. In the least unhealthy urban districts, there dies one in eight or nine, in the first year. In Manchester, one in five dies, under one, and one-half of all that are born there are dead, soon after their fifth year. But in Berlin, Prussia, one out of every three dies within the first year, and half of all that are born there, are dead within two and a half years after their birth. In 1871, 31,262 children were born, and 10,072, or 32.2 per cent., died within that year." †

* Journal Statist. Society, London, March, 1866.

† Edwin Chadwick, in Journal of Society of Arts, London, Dec. 20, 1872, p. 87.

In Massachusetts these facts were as in the following table, during the ten years, 1861–1870 :—

	Births.	Deaths—under one.	Ratio of deaths under one, to births.
Boston, ...	60,354	11,537	19.11 per cent.
Thirteen other cities, ...	80,088	13,863	17.30 "
Rest of State, ...	198,030	24,547	12.39 "

The rate of infant mortality, in comparison with the births, in the thirteen smaller cities, exceeded that of the open country by 39.60 per cent., and that in Boston had an excess of 54.23 per cent. Among the same number of children, born in each of these classes of places, as often as 1,000 died in the country, 1,396 died in the smaller cities, and 1,542 in Boston, under one year.

There are differences in the same city. In four of the districts of London, the deaths under five were from 50 to 59; and in four other districts, these rates were from 101 to 108 in 1,000 living, of the same age. Between these extremes, there were all intermediate grades of mortality in other districts. This is due in part to the different densities of the population, and in greater degree, to the difference in their domestic condition.

Similar differences were found in Boston in 1870, the year of the census. The State Board of Health divided the city into twenty-four districts, according to their sanitary condition. Some of these were low and wet, others were hilly and dry. Some were laid out with wide streets, open grounds, broad sidewalks, and were inhabited by the wealthy and comfortable classes. Others were filled with narrow streets, lanes and courts, and in these were crowded the dwellings and families of the poor. In the most favored districts, the deaths of infants under one, were 86, 100, 167 and 171 in 1,000 living at that age. In the unhealthy districts the mortality was 359, 379, 409 and 486 in the same number of living infants.*

* Report State Board of Health of Massachusetts, 1871, p. 350.

In the most unhealthy districts are the abodes of the poor. Their hard and exhausting labors, their domestic and personal privations, make all external aids of health more necessary to them than to others. But their necessities compel them to live in small tenements, with one, two or three rooms for a family. Dirt, filth, offal constantly gather in their narrow and undrained streets, lanes, alleys and courts, and in their yards, if they be so fortunate as to have them. The public authorities and their agents the scavengers and sweepers, feel little motive to cleanse the places that so soon become foul again, and often, with all their faithfulness and energy, find it impossible to keep the pavement in satisfactory condition. The air without is befouled with the emanations from the ground. And the air within the dwellings is corrupted with the exhalations from the persons of the family and their necessary processes of labor.

There is but little chance for the children or adults to decarbonize their blood with fresh air within, and not much inducement to look for it abroad. The broad streets, where pure breezes blow, the wide sidewalks, where children can play, the parks, commons, squares, that are kept open for the health of the city, are not in their neighborhood, nor within their physical or moral reach, nor are they for such as these who need them most.

Here the family of all ages, and the infants more than the others, have a hard struggle for life, but find no fulness thereof; for "impure air resulting from overcrowding, imperfect ventilation and decaying refuse of every kind, is by far the most fatal and widespread of the morbific agents to which the young are exposed; and this is the most potent among the physical causes of disease." "Moreover, the enfeebled state of the system, induced by the deteriorating effects of vitiated air, is most unfavorable in rendering children unable to withstand the force of epidemic and contagious diseases, to which they are so liable," * and which have their favorite haunts in the crowded districts of cities and among the poor. Hence their high rate of infant mortality.

* Dr. Fraser, in Social Science Trans. 1860, p. 650.

EFFECT OF CIVILIZATION.

One of the most happy consequences or evidences of the advance of civilization is the improvement in human health. The rate of mortality is diminished in every successive age of the civilized world, and especially in infancy and childhood. More infants now survive to the full development of maturity than in the previous centuries. The period of vigor is protracted, old age is deferred, death comes later and the average longevity is increased.

The records of Geneva in Switzerland are the most full and satisfactory for the earlier periods of the world.

The deaths in 10,000 born were,—*

PERIOD.	Under 1.	Under 5.
Sixteenth century,	2,592	4,435
Seventeenth century,	2,372	4,100
Eighteenth century,	2,012	3,316
1814 to 1833,	1,385	2,440

In the first period, one-half died before they completed their ninth year. In the last, one-half survived their forty-fifth year.

Dr. Farr, in Macculloch's Statistical Account of the British Empire, II., 543, says, that the proportion of children raised, has doubled within a hundred years. In London, the proportion of deaths under five were,—

1730 to 1749,	74.5	per cent.
1770 to 1789,	51.5	"
1851 to 1870,	29.8	"

"So great was the rate of infant mortality in London, that an Act of Parliament was passed in 1767, ordering that all parish infants should be nursed six years in the country.

* Mallet in Ann. Hyg., XVII., p. 98.

Before this, almost all parish children died in their first six years." *

According to the Life-Tables, 32 per cent. of all that were born in the ten years, 1728 to 1737, died under one. One hundred years later, only 12.5 per cent. died at this tender age. †

The diseases—especially the epidemic and contagious diseases—were formerly more prevalent and virulent among children in the earlier ages than at the present time.

In London, from 1675 to 1732, convulsions, mainly a disease of childhood, caused 23.91 per cent. of all the deaths. ‡ From 1862 to 1870, only 3.3 per cent. of the whole died from this disease, and in Massachusetts, only 1.8 per cent. since 1843.

In the ruder and less intelligent society that existed one and two hundred years ago, the morbific influences that wasted the lives of children were more prevalent and effective than in the later times. Civilization includes among its manifold blessings, the increase of human life ; all ages enjoy its benefits, but none so much as infancy and childhood.

The growth of intelligence, the increase of wealth, with ameliorations in the personal and domestic condition of the people, the improvements in the comforts of home, in dwellings, in clothing and food, the purification of morals, the softening of manners, the higher conscientiousness and broader and warmer charity,—all are blessings in themselves, and still more in their effects on the human organization. Each one and all these elements of civilization, in as far as it pervades and influences society, families and persons, contributes its due proportion to the development of the constitution, and enables it to ward off the attacks of disease, or to resist its destructive power when it comes.

On the contrary, wherever any of these elements are wanting, wherever ignorance, poverty, privation, negligence or exposure exists, its effect, according to its degree, is felt by the exceedingly sensitive constitution of early life.

Civilization, which in itself is an unqualified good to both manhood and childhood, is yet not unaccompanied with evil.

* Price Annuities, II., 32. † Price Annuities, II., 45, 297.

‡ Corbyn Morris. Past and Present Growth of London.

More plentiful means of life bring temptations and opportunities for indulgence in food and clothing that may be injurious. Fashion, which is not founded on wisdom as its permanent rule, sets at naught sanitary principles when they stand in its way. It often clothes children in a manner rather to please the external eye, than to protect them from the elements and give the tender body that genial warmth that it needs. Sometimes the child is buried in clothes and heated beyond measure. Sometimes one part is overloaded, while another is naked. The head is sometimes oppressively wrapped in cape or hood, while the arms or legs or parts of them are exposed to the full power of the cool atmosphere.

The Child Needs the Mother's Care.

A child is the most precious gift offered to mankind, and brings with it the most sacred and exacting responsibility. To develop its constitution and protect it from morbific influences, require special knowledge of its nature, wants and dangers, and unremitting care and faithfulness in its management.

Nothing is accomplished without the best intelligence and preparation for the purpose. Youth is the time to prepare for the burden of life. Men, regarding this law, seek their way, through pupilage, study, observation, apprenticeship and labor to their field of service in agriculture, mechanics, trade or other pursuits; and when sufficiently trained and educated, they are allowed and encouraged by the world, to become responsible managers and operators in their respective occupations. Then they succeed, in proportion to the intelligence and devotion they bring to their work, and the skill which they apply to the business they undertake.

From the beginning, the law was established that people should marry, and that children should follow marriage. Whatever may be said of the sphere of woman, this precious charge of new-born humanity has ever been entrusted to her. She has ever claimed or accepted this trust. Her physical and moral organization, her possession of the natural nutriment, her tender affection, her inimitable tact and facility of adaptation, give her alone the power to fulfil this responsibility; and more than all others is the mother fitted for this duty.

Intelligent Mothers.

Yet even the mother requires something more than her natural capacities, her loving instincts and her ready sympathies. It is necessary that she be acquainted with the infant nature—its wants and liabilities. But ordinarily she comes to her first motherhood, without preparation, without knowledge of what needs to be done and how she shall do it. With all her good-will and conscientiousness, numerous mistakes are made, the child suffers from errors in diet, clothing, from exposure, from too much or too little nursing. Disease may attack the infant, whose feeble constitution is unable to resist it, and sinks beneath its destructive force.

The records of infant mortality offer a melancholy illustration of the necessity of the mother's previous preparation for the care of her children. The first-born die in infancy in much larger proportion than their successors in the family. The mother learns at the cost of the first child, and is better prepared for the care of the second, and still better for the third and fourth, whose chances for development into the fulness of strength and life, are greater than those of the oldest brothers or sisters.

Children's Nurses.

When the strength or time of the natural family is insufficient for all its diverse operations, and strangers are called to aid in various ways, they are selected on very different principles. Before the dress-maker is employed, assurance must be given that she has so learned her art, that by no error in judgment or of hand, the garments and outward adornments will fail to fit the frame or meet the unrelenting law of taste.

But no such caution is manifested in the employment of a nurse for the little children. The same measure of skill in her occupation is not required. She is not expected to understand the infant's constitution, or to be familiar with its wants, weaknesses and dangers. Nor is the same assurance of discretion and faithfulness demanded of her as of the maker and fitter of garments, before she is allowed to begin her work.

It is not surprising, then, that she sometimes errs in judg-

ment, in respect to the food of the child at home or elsewhere, or to the clothing, the protection from or exposure to the cold or the heat abroad, or that she be occasionally careless or even wilfully negligent. As a necessary consequence, the child's health suffers in proportion to the ignorance and unfaithfulness of its guardian, as the dresses would if the mantua-makers were selected with no more evidence of fitness, or as the father's business would, if his agents had no better preparation for their responsibility than the nurse.

With all the perils that surround the frail organization of the infant, nothing short of the mother's undivided interest and watchfulness can give it the best protection from danger and the best assurance of health and life. This is her highest responsibility; and its wise and faithful fulfilment insures the richest and most enduring reward.

Civilization has more to do for Human Life.

Civilization has done and is still doing much for human life, but it has not yet wrought its perfect work. There yet remain in the nation, in families and in persons, many of the causes of low vitality, and especially in infancy. There are yet poverty and ignorance, with their painful inability to develop the human constitution to its fullest power. There are yet crowded, uncleaned and unventilated districts of cities, with their withering influences on childhood. There are the ignorant, the selfish, the sensual and the self-indulgent parents, to whom the care of infancy is a burden. But these, and many other obstacles to the progress of humanity are gradually diminishing, and with this improvement, infancy becomes stronger and more able to resist the attacks of disease, and fewer children sink by the way from birth to the fulness of maturity.

THE

FOOD OF THE PEOPLE OF MASSACHUSETTS.

By GEORGE DERBY, M.D.,

SECRETARY OF THE STATE BOARD OF HEALTH.

THE FOOD OF THE PEOPLE OF MASSACHUSETTS.

The health and power of a nation, as of an army, depend greatly on its food.

The object of this inquiry is to direct public attention to a department of sanitary knowledge whose general importance every one admits, but which is still only vaguely understood. Our plan has been to learn what forms of food are in common use throughout the State, how they are prepared, and how they are eaten, and then to consider whether this food, as generally used, promotes public health, power and happiness.

In the examination of this question of the fitness of food of various kinds to serve its proper uses, we propose to rely chiefly on the teachings of experience and observation.

Popular writings on dietetics, founded on what is known (or rather half known) of physiological chemistry, can do little or no good. The exact science of the laboratory cannot be applied to the vital chemistry of our human bodies, whose functions are under the control of forces the most powerful and the most obscure. The nervous system of a living man works changes in the condition of the parts of which he is composed, and often in the material provided for his sustenance, which confound the chemist who seeks to explain them by the laws governing inert matter. We know that our capacity for mental and bodily work depends on our supplies of food, but the transmutation of food into energy involves processes which no one can trace. Theory has never successfully guided man in the selection of his food, although science may and does explain his instincts and his tastes. The attempt to reach beyond this point of the corroboration of existing knowledge (the fruit of experience), has led to plausible generalizations on which have been based many systems of popular teaching. These have had their day, and then disappeared, in whole or in part.

For such reasons we shall make but little allusion to the scientific labors of the past or the present in this obscure field of knowledge, believing that the lights which they afford are as yet but side-lights, and offer only such glimpses of the whole truth as would tend to confuse rather than enlighten the unprofessional reader.

The habits of a people springing from varieties of race, from differences of religion and of climate, from soil and the conformation of the country, from occupation, from tradition, and from a variety of circumstances, trivial in themselves, yet powerful in the aggregate, form a subject of singular interest when looked upon as one of purely philosophic inquiry. These habits are of slow growth and are correspondingly persistent. No two nations use the same food, or prepare it in the same way, or eat it in the same fashion. Each nation regards its own diet as altogether the best, and ridicules that of other countries, and each is mainly influenced by pure conservatism, or a prejudice in favor of what is and has been.

We in New England have a certain selection of food growing out of the various circumstances referred to, and we prepare it in a certain manner, and eat it in a certain way. None of these conditions are absolutely fixed; they vary within certain limits, which are governed by individual tastes, by the scale of living as regards expense, and by intelligence. But every one will see, by comparing the table of a Massachusetts farmer or mechanic or laborer, with that of the corresponding classes in other countries, or in other parts of our own country, that the food in common use among us has a distinctive character.

We have taken pains to collect facts relating to the selection of food, and the modes of its preparation for use, in Massachusetts. The information comes from reliable sources—generally from our medical correspondents appointed by the selectmen in the various towns; in a few instances from other persons of intelligence. It is by no means complete; the subject is too extensive to admit of a full examination in a single year; but it may be regarded as a contribution to our knowledge of one of the three great influences, which more than all others affect the health of the people.

Air and its quality is certainly of the first importance, and has been referred to in previous reports of this Board. *Water* has also been considered in some of its relations to health. *Food* may certainly rank next.

The relative value of these three great essentials of life would be differently estimated by many persons, but we have no hesitation in placing air far in advance of food as a means of preserving health. Let any given number of persons of all ages, in the previous enjoyment of health, be constantly exposed to foul air with the best imaginable food, and their health will surely decline. Reverse the conditions; let the air be of the purest and best, and the food of the coarsest and worst prepared, but if it is in sufficient amount, and contains the chemical constituents of which our bodies are composed, health may still be maintained. Insurance of life in the open air should be on more favorable terms than in a printing-office or a tailor's shop, let the food be what it might.

Important as food really is to every one, and especially so to women and children and to persons who from their employment cannot enjoy the constant benefit of pure air, its influence on the maintenance of health is probably somewhat overestimated in popular belief. It is quite natural that this should be so. The process of taking food interests every one, and is constantly recurring. Food is visible, tangible, and appeals to all the senses. Its general uses are obvious to the most ignorant. Both its absence and its excessive use cause illness. It is therefore held responsible for a greater share of the many causes of ill-health than a more careful examination would assign to it. In point of fact, the toleration by the system of such varieties of food as can pass the sentinels of smell, taste, sight and touch, is a very remarkable thing to observe. Let the subject be a man in health, breathing pure air, and taking sufficient exercise, and with liberty to choose what he will eat for his own pleasure, and it is surprising to notice what his powers of assimilation really are. Give the same man equal range of food for his stomach, and deprive him of good food for the lungs by confining him in a crowded, ill-ventilated shop, and his health will surely suffer. With the advantages of air and exercise a man in health may retain his vital force with food in any

form which will supply the constituents of his body; and these constituents are not very numerous, and are found in many alimentary substances.

Or, to put it in another form: a hungry man, in health, having placed before him meat, bread, butter and water, will readily supply himself with all the materials required to repair the waste of his body, and will ask no questions, and need no advice.

But the great importance of nutritious and readily digested food for the people is seen when we remember that but a very small proportion of the whole population is found in the condition of the hungry man working in the open air with all his bodily powers in full force. *First*, there are the children who constitute one-third of the whole people. *Second*, the aged. *Third*, the women engaged in household duties. *Fourth*, the very large class of both sexes (the majority in all our great manufacturing towns), whose occupations compel them to work indoors, and in rooms imperfectly supplied with air.

Lastly, a class of persons of all ages and both sexes (how numerous only physicians know), whose bodily health is feeble from any cause,—people who may be able to attend to their daily avocations, but whose strength is impaired, and whose digestion is imperfect.

None of these persons can properly assimilate food which may be well fitted for lumbermen, open-air laborers, or soldiers on the march.

They require to be supplied with nutriment adapted to their condition of comparative feebleness, and in default of it they suffer.

The question is often asked of physicians whether a certain article of food is, or is not, absolutely wholesome, or good to eat. It is impossible to answer the question, put in this form. It is as unreasonable as to ask a sailor whether the wind is fair, without telling him in what direction you wish to sail. Very few articles ranked as food are absolutely unfit to eat; or, if not repulsive to the senses, may not be good under certain circumstances. A man laying stone-wall, or mowing in the field will not only digest, but thrive upon forms of food which would be very unwholesome for a man employed

in a shoe-shop, or a woman working in a factory, or at hand-sewing, or straw-braiding, or teaching.

Among the many causes of consumption this want of proper food is surely one. We know, by abundant experience, that the progress of this disease is stayed by appropriate nourishment, whether in the form of food, properly so called, or of its substitute, cod-liver oil. We know that a poor diet surely hastens the fatal event. And we have good reason to believe that the many forms of dyspepsia which are so commonly met with among all classes in Massachusetts, in country quite as much as in town, are but too often the danger-signal that nature gives us to show that *the food*, either in its quality, or its preparation, or its variety, is unsuited to maintain the vital processes. If this warning is neglected, the flesh wastes, the color fades, and the result of malnutrition is not unfrequently confirmed consumption.

The elements of repair of all the tissues of the body may be placed before a person of feeble digestion, and may utterly fail to accomplish their purpose; and the efforts of the stomach to assimilate and reduce them will only aggravate the original difficulty. It is but a modified form of starvation with the mockery of a display of abundant food.

The following circular was sent to our correspondents in the various towns as a means of collecting information on the subject of food.

FOOD.—Is the food in common use among the people conducive to health? Under this head we would like your observations on the following points, among others:—

1. Is the food in common use sufficiently varied in kind?
2. Are the proportions of fresh and salt meats, of vegetables, and of the various forms of farinaceous food such as you approve?
3. Have the farms good vegetable-gardens, and the means of storing vegetables so as to keep them in a fresh and wholesome condition?
4. Are the modes of cooking food of all kinds as good as can be employed?
5. What kinds of bread are chiefly used,—wheat, or corn, or rye, or mixed?
6. Is bread generally well made and well cooked?
7. Are any forms of pastry extensively used as substitutes for leavened bread?
8. Is the use of tea and coffee judicious in amount, and quality, and strength?

The replies to this circular have been very numerous. Many were monosyllabic, or nearly so, and we have tried to

put them in tabular form, but it has been found impossible to fairly present the opinions of our correspondents in this way. The more extended replies which we give seem to freely express the belief entertained by physicians in every part of the State.

On this question of food and cooking there is much reticence, and it may be attributed to causes which all may respect. The country physician breaks bread with the families who employ his services. He is often their honored and favored guest. The indisposition which he might feel to tell the good housewives at their own tables that their bread or meat were not good may also influence his pen. To complain of the food would be in a certain sense a breach of hospitality. However this may be (and all readers will judge whether it would influence the testimony), the information contained in our letters is given as follows :—

In a community like this, made up of comfortable farmers, the food is of a good kind and sufficiently varied. Cooking is of doubtful excellence; much good food, which a French cook would make delicious (if not healthful), is made into despicable messes. Wheat, rye and Indian, and Graham bread are all used, and the bread is good. Pies, of every imaginable quality, are almost universally used, not as a substitute for bread, but as supplementary.

Tea and coffee infusions are generally very mild, and there is rarely occasion to regulate their use.

Food varied and in proper proportions. Vegetable-gardens with the farms, and the vegetables well stored. It is doubtful if the modes of cooking are as good as may be. Wheat is chiefly eaten, and the bread is well made. Pastry is not used as a substitute. Tea and coffee not judiciously used.

[A factory and farming town.]

Except among the very poor, the food is sufficiently varied and good in quality. Vegetables are abundant. The frying-pan is used altogether too much in cooking. Wheat and brown bread are both eaten. The Irish use only wheat. The bread of the Irish seems to be good. Among Americans it is often very bad. In most families the coffee is very weak and poor. Tea is used excessively and harmfully.

Food is not sufficiently varied. The poorer class of foreigners live almost entirely on wheat bread. All classes use too much fine flour. Many families

are nourished almost exclusively on salted meats and hot bread or biscuits, improperly cooked. Others err in eating too much fresh meat in hot weather; very few changing their diet with the seasons. But there is improvement in both respects during the past ten years. Too much pastry is consumed. Scarcely a meal is eaten without pies. Tea is used excessively.

[A manufacturing town.]

Food is generally suitable and sufficiently varied. In the sparsely settled portion of the town, too much salted meat is used. Vegetables are plenty and well preserved. Cooking is usually good, but meats and vegetables are often underdone. Bread is not well made, but is varied in kind; it is too often eaten hot. Tea and coffee are seldom detrimental. Pastry is not excessively used, but insoluble compounds of flour, sugar and fat are too often met with.

Food is varied and in good proportions. Vegetables are plenty and are stored in cellars. Cooking is a failure. Mixed varieties of bread are used, and they are well made. Pastry is used more than it should be. Tea and coffee injudiciously used. The habit of eating hastily is productive of more injury than the kind of food eaten. The shoe-business is the chief interest here, and large numbers of both sexes are employed in the "steam factories," and board or live in hired houses, with little idea of a "home." A few, comparatively, work in shops near their own dwellings, and as a general thing this class is better fed and cared for.

Food is not varied sufficiently, nor are the proportions approved; the meats are mostly salt. Vegetables are plenty and well kept. Cooking is good, but could be improved. Wheat bread mostly used, and it is well made and cooked. Pastry is much used, but not as a substitute for bread. Tea and coffee intemperate in amount.

Our people are farmers, and their diet is plain but well varied. Vegetables used and well stored. Cooking satisfactory. Wheat bread the chief; it is well cooked. Very little pastry used. Tea and coffee are used judiciously.

[The six following letters are from farming towns.]

Food varied and in proportion, with the exception that salt pork is in some localities too much eaten. Vegetables raised and well kept. Modes of cooking as good as the average. Wheat bread, well made, in common use. Pastry not used in substitution. Tea and coffee judicious in amount and strength, but not in quality.

Food well varied; too much salt food in summer. Vegetables, plenty and well kept. Modes of cooking "palatable." Wheat bread, generally well made, used, without much pastry.

Food satisfactory in variety and proportion. Vegetables raised and well stored. Modes of cooking approved of. Wheat and mixed breads used; they are well made and cooked, and very little pastry is used. Tea and coffee are used to the detriment of health.

In *most* families in this town the food is sufficiently varied and its different elements are in good proportion. The same half-commendation may be applied to the cooking. Vegetables are abundant and well kept. Wheat bread is in common use. The farmers also use corn and rye.

In a great many families the bread is neither well made nor well cooked, but in the houses of most of the people it is good. Nearly all our people drink either tea or coffee three times a day with their meals,—a thing, by the way, never done by the Turks or Chinese or other Asiatics, who taste it in very small quantities between meals. I meet with many cases of derangement of the digestive and nervous systems which resist all remedial treatment so long as the patients continue the use of either tea or coffee, but which are speedily relieved after abstaining from their use. The Japan and green teas are more injurious than the black teas.

The proportions of meats and vegetables are not what a judicious physician can approve of. Too much salt fish and salt pork. The modes of cooking are generally inferior, and in many cases positively injurious. Wheat is generally used for bread; poorly made and cooked, and eaten hot. Pastry is not used extensively. Tea and coffee are used intemperately in quality and strength.

There is great want of personal cleanliness among the people. Sleeping in small rooms, the system becomes more or less loaded with a poison engendered within itself.

The food is in good variety and proportions. Vegetables are plenty and wholesome. The cooking "may be improved." Wheat is the kind of bread chiefly used; it is indifferently made. Pastry does not take its place. Tea and coffee of inferior quality are in use.

[The following letter is from a physician of large experience, and one well acquainted with the people of Massachusetts, whether living in towns, or in the agricultural, or the maritime districts.]

I give you the subjoined hasty views in reply to the printed interrogatories forwarded me.

1. Is the food in common use among the people conducive to health? Is the food in common use sufficiently varied in kind?

Answer.—In the range of my observations in fishing communities early in my life and late among agricultural people, I do not think the general physical condition of those pursuing the above avocations impaired by the want of variety in the food in common use.

The finest looking men, the most robust and with capacities for great endurance, were the fishermen.

Their food whilst following an occupation so conducive to health was fish, pork, potatoes and hard bread, with fresh meat but rarely. They lacked nothing in virility, their wives were prolific and their children the hardiest in New England. It was then, and I suppose it is now, the custom for invalids from the rural districts suffering from chronic indigestion or incipient phthisis to tempt the sea with these hardy adventurers, and often with the most favorable results.

In the agricultural communities under my observation there is not as much variety in food as there was forty years ago. The quality of it is not so good and the cooking of the same greatly deteriorated.

Our farmers, however, eat more fresh fish than formerly, from improved facilities in transportation, and on the whole I should say, there was no perceptible impairment in the physical condition of those engaged in out-door pursuits, from a lack of variety in the food, but deplorable results from the manner of cooking it.

Many of the children of the poorer classes who pick up what they can in the way of food, are yet hardy and healthy looking, *because they enjoy the light and warmth of the sun and have plenty of pure and wholesome air.*

2. Are the proportions of fresh and salt meats, of vegetables and of the various forms of farinaceous food such as you approve?

Answer.—I should say yes, with the exception of the farinaceous forms of food. There is not sufficient variety in the kind of bread in use in the manufacturing towns and villages, and among the laboring classes engaged in other occupations.

3. Have farms good vegetable-gardens, and the means of storing vegetables so as to keep them in a fresh and wholesome condition?

Answer.—The farmer tilling his land near cities, manufacturing towns and thriving communities, derives most of his income from the sale of milk and the products of his vegetable-garden. The laborers on these farms (mostly unskilled foreigners) are not generally so well fed as the help of the farmers were in the good old times, when they ate at the same table with their employers *and remained with them until their majority.*

I do not think the smaller farmers pay so much attention to vegetable-gardens as formerly, but I think the evil from poor storage of vegetables greatly overestimated.

4. Are the modes of cooking food of all kinds as good as can be employed?

Answer.—Modern civilization, progress so called, tearing away the old-fashioned open kitchen fire-places, where a johnny-cake could be baked on a board, and eaten with sweet butter and served with a rasher of pork (food fit for a king), has produced the same physical deterioration among our people, as the substitution of a hole in the floor for the open fire-places of our forefathers has caused in their minds and morals.

It is dreadful to contemplate the evil results of our modern appliances for warmth and cooking.

5. What kinds of bread are chiefly used—wheat, or corn, or rye or mixed?

Answer.—Good house-wives who have not forgotten their grandmothers, use a sound and salutary discretion, but as a general thing wheat bread is too extensively used.

6. Is bread generally well made and cooked?

Answer.—No.

7. Are any forms of pastry extensively used as substitutes for leavened bread?

Answer.—Too much so for the health of the community.

8. Is the use of tea and coffee judicious in amount and quality, and strength?

Answer.—The moderate use of these beverages when pure and unadulterated is comforting and beneficial to health. Their inordinate use, and particularly when they are substituted for nourishing food and drinks, is a prolific cause of anæmic diseases and neuralgia.

Food varied and in proper proportion. Garden vegetables cultivated and well preserved. The use of vegetables and small fruits has much increased of late years. Cooking is good. Flour bread chiefly used; it is well made. Pastry is used a good deal, but rather supplementary to than as a substitute for leavened bread. Tea and coffee are used judiciously.

"There should be less pastry and more corn bread." Vegetables raised and stored properly. Cooking, good. Mixed breads used, but wheat is the chief; it is well made. Pastry is used, but not as a substitute for bread. Tea and coffee are used temperately.

Food varied, well proportioned and well cooked. Vegetables used and stored properly. "Mixed" bread, well made, in use. No forms of pastry extensively used. Tea and coffee judiciously taken.

The food in common use is not as varied in kind as it ought to be. The farming people live largely on salt pork, salt fish, potatoes and bread. The factory people do better, but their food is too often carelessly prepared. The farmers have kitchen-gardens, which are very often neglected and unproductive. Cellars are ample for storage, but vegetables are not usually cooked well. "Boiled victuals," the old New England preparation of garden vegetables, is very common. Every kind of grain is used for bread, except oats,—and oatmeal is sometimes found among Canadian and Nova Scotia families. Bread is almost never nicely made and baked. I am often obliged to take meals away from home, and it is rather uncommon to find wholesome food of any kind. Pies are much used among American families. Strong tea injures some of our people. Coffee is not much used.

Food varied in kind and proportion. Vegetables well kept. Cooking, satisfactory. Wheat bread, well made, is in general use. Tea and coffee are not used to excess.

[Martha's Vineyard.]

Fish and fowl abundant; meat less common, and fresh meat especially so. All the farms have gardens and good cellars; and vegetables are abundant, but not in sufficient variety. There is too much frying; otherwise the cooking is good. Wheat bread is the staple; it is well made. Corn and rye bread and corn bread are also used. Pies and cakes are the worst features in the diet of this community, and most conducive to indigestion; they are eaten indiscriminately for breakfast, lunch, dinner and supper. Tea is used judiciously and is more common than coffee; cocoa is occasionally used.

I think the food in use here is conducive to health. Half of our population are of foreign birth, and are employed in the mills. In so far as the raw material goes, their food is, on the whole, good in quality, quantity and variety. The cooking is poor, except of bread, which is good. Tea is of fair quality, but is used too strong by the females. Coffee is much adulterated, as bought of the grocers.

[A farming town.]

The food is judiciously varied in quality and proportion, except that salt meat is mostly used in summer instead of fresh. Vegetables are freely used and are stored in cellars. Cooking might be improved. Wheat bread is chiefly used; it is generally made well. Pies are too much eaten. Tea and coffee are used of injudicious strength.

[From a large city.]

Among the poor, the food is insufficiently varied. The modes of cooking are inferior. All kinds of bread are used, and the baking is bad. Pastry is used extensively, but not as a substitute for bread. The quality of tea and coffee is poor; their strength injudicious.

The food is varied in kind and proportion; vegetables are freely raised and well stored. The cooking is satisfactory. Flour bread is chiefly eaten; it is not well made; pastry is not used too much. Tea and coffee are taken judiciously.

Food varied and properly proportioned. Vegetables "the best in the State." Cooking is inferior. Wheat-flour bread, ill cooked and eaten hot. Pastry is used extensively and injuriously. Tea and coffee are used by all, but judiciously.

Food in good variety and properly proportioned. Vegetables well provided for. Modes of cooking satisfactory. Wheat bread chiefly used. Tea and coffee in proper use.

[A market-gardening town.]

Food varied and in good proportion. Town famous for its vegetables; they are stored in barn-cellars and in furrows and very little in kitchen-cellars. Cooking, good. Wheat bread chiefly used, and cooked. Pastry is not used to the exclusion of bread. More corn and rye recommended as breadstuffs. Tea and coffee in general use but not to excess.

[A farming town.]

Food sufficiently varied in kind and in proportion. Vegetables abundant and well stored, Wheat bread, the staple; it is "pretty well" cooked. General modes of cooking might be improved. Meat fried too much. Pastry, made very sweet, is too much used. Tea and coffee used temperately.

[Cape Cod.]

Food varied. Plenty of vegetables. Wheat bread mostly used; it is not well cooked. Cake and pies are extensively used. Tea and coffee are of inferior quality.

[Essex County.]

Fresh meat in general use. The farmers usually have good vegetable-gardens and the means of storing vegetables. The kind of bread used is mostly wheat; the bakers are largely patronized.

[A farming town.]

Food varied and in good proportions. Vegetables in abundant use. Modes of cooking generally satisfactory. Mixed forms of bread are used; and they are well cooked. Pastry is not used exclusively. Tea and coffee in judicious use.

[Cape Ann.]

The use of fresh fish affords a wholesome variety of easily digested and nutritious food. In this respect our people have an advantage over those living away from the sea. Vegetables are extensively cultivated for the markets, and are a source of profit. There is too much frying in fat. Our women understand the cooking of fish in every form. Bread is made from various grains, but the use of wheat bread has much increased of late years. In some families it is well made; in many others too little attention is given to the "rising," and the bread is heavy and sour. It is also eaten too soon after baking. Coffee and tea are largely consumed. Coffee is too often boiled with molasses, and makes a villanous compound.

I believe that a poor diet tends to produce consumption, and have no doubt that this disease is less frequent in this town than formerly, because the mass of the people are better livers. A striking illustration of the influence of this cause is found in the history of a large family, which has perished by consumption since I took up my residence here. Father, mother, seven or eight children, and several grandchildren have been swept away by this disease. Speaking of this family to a rather rough but shrewd neighbor of theirs, and remarking that it was strange they should die in such quick succession, he exclaimed: "Not strange at all. It served him right. He was so stingy that he never allowed himself or his children enough to eat. He brought up his family on slops, and that is the way he got his pay for it." If the inner history of many families were known, a similar judgment might be justly made.

Food not sufficiently varied. Cooking, careless. Wheat the staple for bread; the bread is not well cooked and pastry is too much used. Tea and coffee are not used judiciously.

[A farming town.]

Food in good variety and in proportions favorable to health. Sufficient care in storing vegetables is not taken; the cellars are sometimes damp and promote disease. Cooking, generally good. Wheat, corn and "mixed"

breads are used; no fault found with the cooking. Pastry is not used as a substitute but as a supplement for bread. Tea and coffee are sometimes used too strong, causing sleeplessness.

Food varied and in good proportion, with plenty of good vegetables. Cooking, generally good. Wheat, with a good proportion of corn and rye, in use for bread; the baking is good. Pastry is used in considerable amount. Tea and coffee in good amount but poor quality.

Fresh meat is the exception in daily use. Vegetables are used freely. In cooking, there is too much frying. Flour bread is the common staple, and improvement in its cooking is noticed. Tea and coffee are used judiciously.

Too much pork eaten, and in general too much salt meat and too few vegetables. The cooking, satisfactory. The bread,—wheat; well made. Tea and coffee in general use, the tea too strong.

[Connecticut Valley.]

Too much salt food is used, but a change for the better is evident. More attention is also given to raising and storing vegetables. Too much frying and cooking in fat. Wheat mostly used as the breadstuff; the bread is generally well made. Pastry is not used as a substitute for bread. Tea and coffee in some excess, especially the former.

Too many "condiments." Cellars are damp, and thus ill adapted for storage of vegetables. Cooking as good as the average. Wheat almost the sole staple for bread; it is cooked well. Pastry is not used as a substitute, but as supplementary to bread. Tea and coffee "as good as can be obtained."

Food is varied and in good proportions. Vegetables abundantly raised and well stored. "No better cooks on earth." The bread is varied and beautifully cooked. Pastry is not used as a substitute for bread. Tea and coffee used healthfully.

The food is not sufficiently varied; the vegetable-garden is not attended to. Cooking is of doubtful excellence. Wheat is the common breadstuff. Pastry does not take the place of bread. Tea and coffee are generally used with moderation.

Food is not varied enough, and its proportions should be improved. Vegetables are raised but are not well kept. Modes of cooking inferior, as a general thing. Wheat bread, poorly made, is common. Pastry is not much eaten instead of bread. Tea and coffee, poor in quality.

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Pork is too generally used. Good vegetable-gardens. Cooking, inferior; meats are too often fried. Corn and rye mixed, wheat and oatmeal the usual breadstuffs. Bread generally well made, but too often eaten hot. Pastry is too freely used. Tea and coffee not generally abused.

Food is varied here, and in good proportions. The cellars are well adapted to keep the vegetables in good order. The cooking is satisfactory. Wheat bread, generally well made, is the common form. "Artificial" coffee is used without ill effects.

The variety and proportions of food are satisfactory. Vegetables are raised and well kept. Cooking is inferior. Wheat bread is the rule, and it is well made. Tea and coffee are used with moderation.

The food is varied, and the facilities for obtaining it very good; markets are depended upon, and they supply the demand fully. Wheat bread is most used. The cooking is quite well attended to. The use of tea and coffee is not excessive.

The food is sufficiently varied for health, and is properly proportioned. Well-kept vegetables are abundant. Modes of cooking are open to improvement. Bread is chiefly made from wheat, and is well cooked. Tea and coffee are generally used temperately.

The food is used in proper variety and proportions. Some cellars are wet in the spring, but the storing of vegetables is, in the main, well cared for. Cooking is good. Bread made from wheat, and well cooked, is the rule. Pastry not used too much. Tea and coffee taken judiciously.

Food varied and generally in good proportions. Vegetables are raised freely and stored properly. Wheat bread, well made, in common use. Hot pastry too general. Tea and coffee, for the most part, used judiciously.

This community is well supplied with food, as regards variety and quality. Situated as we are, near the salt water, fresh fish are abundant. The surrounding farms furnish a good variety of vegetables. The modes of cooking food should be included in the course of study in the public schools. The bread as furnished by the bakers (wheat bread chiefly), is well made and well cooked. Pastry is not much used. Tea and coffee used judiciously, the former more freely than the latter.

Food in proper variety and proportions. Vegetables abundant and in good condition. The modes of cooking are better than the average. Wheat bread, well made (better than formerly), is the rule. Tea and coffee generally used judiciously.

Food is fairly good. Fresh meats and fish are within the reach of all. No farms of any size exist here; garden vegetables alone are raised.

"Too much salt fish is used, and children should take more milk." Good vegetables are plenty. Cooking is well understood. Wheat bread, well cooked, is very generally used. Pastry is not used as a substitute for bread. Coffee is used impure; neither tea nor coffee used injudiciously otherwise.

Food is varied and well assorted, on the whole. Modes of cooking inferior. Bolted wheat bread is the rule. Pastry very generally used. In mechanics' boarding-houses, pies are eaten at almost every meal; they are as heavy as lead, and take the place of bread to a great extent.

The food in common use is believed to be conducive to health. "Mill-operatives and the poor, as in every other place, are more liable to get too much salt meat, unwholesome stale vegetables, with the poorest of cooking."

[A farming town.]

If people die of consumption, acquired here, it is because they sleep in little, close, impure bedrooms on the ground-floor, never bathe but once a week, at the best, and eat little meat except fried salt pork. The butcher runs through the town once a week, and the baker just as often. What with fried salt pork and heavy brown bread, and poor butter, and bad air, and closed pores, it is only a wonder that they live as long as they do.

Food varied; too much salt meat. Good gardens; storage inferior. Modes of cooking open to criticism; too much frying. Wheat bread, well cooked, is the rule; pastry does not take its place. Tea and coffee judiciously used.

Food well varied; the quantity of fresh meat might be advantageously increased. Good vegetables are plenty. The cooking is generally satisfactory; fresh meat is overdone. Wheat bread or corn bread are universally eaten; well made and well cooked. Pastry is not used to the exclusion of bread. Tea and coffee are generally used; the coffee is a "vile imitation."

The variety and proportions of the food in use are satisfactory. Vegetables are raised and well stored. The cooking is of doubtful excellence. Wheat bread principally eaten; it is well cooked. Pastry not used as a substitute but as a supplement. Tea and coffee usually satisfactory in strength, quality and amount.

[A boot and shoe town.]

The same unvarying round of pies, cake, tough meat poorly cooked, boiled tea and muddy coffee is repeated day by day. Too much salt meat and salt

fish are used, and too little farinaceous food. Indian meal and oatmeal are more used of late, but when in form of pudding are insufficiently boiled. Oatmeal simply boiled in water, with salt, for one hour at the least, then allowed to partially cool, and eaten with milk and sugar or molasses, makes an excellent breakfast dish, and its general use would be beneficial. Few vegetables are raised here and the means of storing them are deficient. As a general rule the modes of cooking are semi-barbarous. Frying is universal. Fresh meats and fish are seldom boiled. Soups are almost unknown, except among the Canadian French. The majority of families in this town eat pie at every meal. Doughnuts and "turnovers" (that is, pastry folded on itself with cooked fruit inside, fried in lard) are also in general use for supper or breakfast. The pies are usually underdone. Pies, doughnuts and cake are extensively used as substitutes for leavened bread; many families also use crackers as a substitute for bread, buying a barrel at a time. A ten-cent loaf of bread sold at the baker's in this town weighs one pound and thirty grains. A ten-cent loaf bought in Boston weighs one pound and a quarter and is of much better quality. Tea is commonly taken with dinner. Both tea and coffee are poorly made, but improvement in this respect is observed of late.

Food is well varied and its proportions are satisfactory. Vegetables are raised and properly stored. The modes of cooking are defective. "Brown bread" among the farmers; wheat bread among the mill-operatives; the baking is good. Pastry is not used as a substitute for bread. Tea and coffee are often taken with injury. The coffee is a "vile compound."

Food varied and in good proportions. Vegetables raised and kept in good order. Cooking is satisfactory. Wheat bread, well made, is the principal form. Unbolted wheat is becoming more common. Pastry is not used as a substitute for bread, but as an adjunct. Tea and coffee are used judiciously

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Food is well varied; and in general, is well assorted. Vegetables are raised in plenty and are well stored.

Food varied and in proper proportions. The cooking is satisfactory. Bread is made of wheat flour and is well made. Pastry is not too much used. The use of tea and coffee is temperate and judicious.

More fresh meat recommended. The cooking is good. Leavened wheat bread is generally used, and it is well made. The tea and coffee are too strong.

[Martha's Vineyard.]

Food is varied and in proper proportions. Vegetables are raised and stored well. The cooking of meats is carried too far and the frying-pan too often takes the place of the gridiron. The bread is made chiefly of wheat, but other materials are considerably used. The bread is well mixed and

well cooked, but it is usually either made with saleratus, or Horsford's Powders, instead of yeast.

Too little meat eaten, especially among mill-operatives, since the prices were so high. Vegetables are plenty and wholesome. Cooking not above reproach. Wheat bread, well made. Tea and coffee are often used too strong; and the amount of nutritious food taken is lessened in consequence. Coffee, as commonly sold, is greatly adulterated.

The food is becoming more varied. Vegetables are more generally raised and the storage of them is good. Cooking of bread is satisfactory. The bread is made of wheat flour more than formerly, but the farmers retain the "rye and Indian" still. Tea and coffee are used judiciously.

Too much salt pork and too little fresh beef eaten. Vegetables and their storage are deficient. Cooking is too hastily done and frying is general. Many farmers suffer from indigestion. Mostly, wheat and corn are used as breadstuffs; the bread, as a rule, is poorly made and indigestible. Pastry is more common than formerly and consists of villanous compounds. Pure teas and coffees scarce ever seen.

Vegetables are abundant. Cooking might be improved. Wheat bread is generally used and it is well made. Pies are eaten too frequently, but not instead of bread. Too much tea is used. Coffee less in use than formerly. Dyspepsia is so common that it seems as if the food must be responsible for it, at least in part.

[A factory town.]

Food varied and well assorted. Vegetables are abundant and wholesome. "The modes of cooking differ with the different nationalities represented here. The Canadians use a large proportion of fresh pork, boiled or fried, with potatoes, onions, pea-soup and bread; the Irish use beef, pork, fish and eggs, with potatoes, cabbage and bread; the Germans are much inclined to beef and soups, with a variety of vegetables and bread; the English stick to mutton and beef, with vegetables and bread; our natives use a greater variety than any other class." Wheat bread, with some corn and rye mixed, usually well made. Pastry is not extensively used as a substitute for bread. Too much tea and coffee are used; the quality is poor and the amount and strength such as to impair digestion and produce disorder of the nervous functions generally.

Pork is used too liberally. Vegetables stored in house-cellars. Frying too common. Wheat bread general, well made and well cooked. Pastry not used. Tea and coffee used, but the correspondent states he has "not been *troubled* with their strength."

Food varied, but too much fresh meat is used in the hot season. Vegetables are obtained from Boston in a poor condition. Frying too common.

Flour bread, poorly cooked, in general use. Pastry is used as a substitute for bread. Tea and coffee are used too strong.

Food is varied and well assorted. Vegetables are unusually good in this town. The cooking is of doubtful excellence. Wheat bread, cooked well, is chiefly used. Pastry is not used as a substitute for bread. Tea and coffee vary much in quality and people are injudicious in the quantity they drink.

There is not sufficient variety in the kinds of food in common use, especially among farmers, and women who do their own work and whose husbands dine in Boston. There is too much salt meat and salt fish, and not enough of fresh vegetables and fruit. There is too much frying.

There is much market gardening and the means of storing vegetables are sufficient. Wheat bread is generally used, made from the finest flour, but I can see a decided increase in the consumption of "mixed" bread. Pies and cakes are too much used, but less than formerly. Many families use tea at every meal, and many hard-worked housekeepers nerve themselves up with strong tea and spoil their appetite for wholesome food as well as ruin their digestion.

I think the relative proportions of different articles of food are better preserved in our farming and semi-farming communities than elsewhere. There are generally plenty of vegetables but they are badly kept in moist, unventilated cellars, whence the odors of decay escape into the rooms above. No one seems to know that a south window may be kept open. Frying meat is still more common than broiling, but the change in this respect is slowly in the right direction. Both wheat and mixed or brown bread are used. There are more people who know how to make "raised bread" than there were twenty years ago, although many mix it with milk. More than half of the flour is mixed with cream of tartar and similar substitutes for yeast. The use of pies is general.

Food is well varied and proportioned. Vegetables are plenty and are kept in good condition. The cooking is inferior; there should be more boiling or broiling. Wheat-bread, well cooked, is in general use. Tea and coffee are used judiciously.

Food is not sufficiently varied or assorted. Vegetables are well preserved, as a rule. The cooking is inferior. Fine wheat is used for bread, to the exclusion of rye and corn. The bread is generally well made. Pastry is too much used, excluding meat rather than bread. Tea and coffee (the latter poor in quality) are in general use.

The food is varied and well assorted. Vegetables are abundant and well preserved. The modes of cooking are probably not the best. Wheat bread, poorly cooked, is in principal use. Pastry is not used as a substitute. The tendency is to drink tea and coffee too strong and in too large quantities.

[Cape Cod.]

Food varied and well assorted. The farms generally have good vegetable-gardens and the means of storage. The modes of cooking have improved within twenty years, but are still open to criticism. Wheat bread, generally well made, is chiefly used; and pastry is not used much. Tea and coffee are used judiciously.

The food in common use is not conducive to health. Among the mechanics, too much pastry is used and too little meat and vegetable diet. The farmers have good vegetable-gardens. In cooking there should be more boiling and roasting, and less frying. Wheat bread and "hot cakes" are in general use. The baking is poor. Hot cakes are eaten for breakfast. Tea and coffee are used judiciously.

The food is not sufficiently varied among the poorer classes; too much salt pork is eaten. The vegetables are raised plentifully, and are well stored as a general thing. Wheat bread is in general use. Pastry is not used as a substitute. Tea is drunk too strong and in too great amount. Coffee is less used than tea.

[The seven following letters are from different physicians in a large inland city.]

Food is well varied and in good proportion, with plenty of vegetables, well stored. Cooking is generally satisfactory, but meats are fried too much. Wheat and corn and rye mixed comprise the breadstuffs. I find the poorest bread in American families. Pastry is not used as a substitute. I think there are large quantities of poor stuff drunk, called tea and coffee. The women use tea excessively, especially the Irish.

Food is varied and in good proportion. Good vegetable-gardens and good storage. Bad cookery prevails. Wheat is almost entirely used, and the bread is well made. Comparatively little *good* tea and coffee is used. A vast amount of *slops* is, however, consumed. That this is a fruitful source of dyspepsia I have no doubt.

Our people are very good livers, and errors in the proportions of diets are seldom recognized. Cooking is pretty good for American cooking. Wheat is almost exclusively used. Bread, of which Indian meal is a principal ingredient, is a very active element in causing dyspepsia, and many such cases have come to me from Northern Rhode Island. Pastry is not used as a substitute for bread. The Irish people, and especially the females, often seem to injure themselves in their nervous systems, and their digestion, by deluging their stomachs with tea and coffee.

I think that too much Indian meal and hot bread are used. Dyspepsia is a very prevalent disease, and dyspeptics cannot certainly use them with impunity. The out-door laborer can digest almost anything. There is too much frying, and the American method of cooking bread is inferior. Wheat

and corn and rye mixed are the breadstuffs. Pastry is not used extensively. Nervous women generally drink too much tea. I think the quality of the coffee and tea used might be greatly improved.

The variety and proportions of food are satisfactory. There are good gardens and good storage for vegetables. The modes of cooking are not the best. Farmers use corn and rye for bread, city people use mostly wheat. The bread is not cooked in the best manner. Pastry is a common substitute among Americans, less with Irish and Germans. Tea and coffee are both often of bad quality, and both are often used too strong, especially among females.

The variety and proportions of food are, as a rule, satisfactory. The raising and storage of vegetables are generally commendable. The modes of cooking might be improved. Wheat bread is in common use, and the bread is well made and well cooked, especially among the Irish. Pastry is not used.

The food is varied and its proportions are approved. The farms have good vegetable-gardens and good storage. The modes of cooking are inferior. Wheat bread is mostly used,—not sufficiently cooked in many families.

[From a farming town.]

The food is sufficiently varied in kind and proportion. The means of storing vegetables are satisfactory with three-fourths of the people. "Meats are too often cooked by frying, whereby the fibre is too much hardened, and hot fat combined with them." Bread is made of "wheat flour, unbolted wheat and mixed corn and rye. It is generally well cooked, but it is not always made in a manner most conducive to health; too much is made with soda and cream of tartar instead of yeast or leaven, and the bread is too often eaten hot. Pastry is extensively used, in the form of pies, and sometimes to the detriment of health. It is often a substitute for meat. A small proportion of the people use tea and coffee of too great strength; but the chief fault is the use of cheap substitutes for coffee, in which there is little or no coffee taste."

[From a farming town.]

There is great irregularity in the variety of food; at some portions of the year there is a good variety of animal and vegetable food. In autumn we generally have fresh meat in variety and abundance, also vegetables and fruits; in winter, people are more restricted, using pork in some form mostly for meat; in spring the change is slight, there being some fresh beef and a mixture of salt meats, tripe and fish; and the same may be said of the summer, except that there are fewer vegetables during the latter part of spring and summer than at any other time. This deficiency is met in part by the use of "greens" of various kinds. Potatoes are in use most of the year. Most farms have very good vegetable-gardens, but the means of storing vegetables are limited to the cellars under the houses, and these are many times small, and generally without any winter ventilation except what

chance may obtain; therefore I do not think the storage is such as to keep vegetables in a fresh and wholesome condition, and certainly, the exhalations from such cellars cannot be conducive to health.

Food is mostly cooked in a tolerable manner. Wheat is probably used as the chief bread-stuff, although nearly every family uses some corn or rye, or the two mixed. I think the bread is generally well made, being fermented with yeast. I do not think pastry is extensively used instead of leavened bread. Tea is used quite extensively in this region, the Japan variety being the favorite. Coffee is but little used comparatively, and it is of poor quality, being roasted and ground,—a vile compound with a strong taste, with but little, if any, of the coffee flavor, and many extol such mixtures of pease, barley, carrots and chicory more than they would a purer article. The strength of the beverages is moderate, and the amount used is not excessive.

[From a factory town.]

The food in common use is sufficiently varied, with the exception that in my opinion too much fine flour is used. The Irish generally make excellent bread, of the best of wheat flour, which is the kind generally used. This is a manufacturing town, and the farmers are few. Leavened bread is the general rule, but in many of the boarding-houses, unleavened bread is used for breakfast. Tea and coffee are universally used; the former is generally very good, the latter, very poor, being ground and largely adulterated. In my opinion, too much swine's flesh is used in an unsalted condition, and it is generally fried, which is very objectionable.

Food is sufficiently varied and in proper proportions. Good vegetable gardens and good storage. Modes of cooking, on the whole, good. Wheat bread in chief use; its cooking might be improved. Pastry is not used as a substitute for bread. Except in the use of Japan tea, coffee and tea are used judiciously.

[From the late Dr. John Dole, of Amherst.]

The food in common use is now sufficiently varied in kind, a marked change for the better having occurred in this matter within the past five years. There has been until lately, an undue proportion of salt food used. "Corned beef" and salt pork have been the chief articles of meat diet among a portion of the farming population, owing partially to want of access to butchers, and partly to want of knowledge as to what was really desirable for thorough nutrition. But of late, physicians have taken pains to advise in this matter, and the people are easily accessible to ideas. I have carefully noticed this point, and have been struck with the change for the better. Many of the farmers have good gardens, and store their vegetables with care. Food is better cooked than formerly. The frying-pan has been in a great measure displaced by the gridiron in the cooking of fresh meat. The use of coal instead of wood, has brought about changes in the character of cooking and of cooking utensils. The old-fashioned oven has been superseded by stoves and ranges, and the change of fuel tends to insure a steadier temperature in baking, roasting, etc.,—on the whole, an improvement. Wheat bread is largely used. The rye bread is of good quality, generally well cooked and nutritious, and is used very commonly among the

farmers, and to some extent among all classes. I have not known of any form of pastry used as a substitute for leavened bread. Tea and coffee are used quite commonly. Coffee, or some substitute for it, such as rye, chicory or beans, used almost universally once a day. Tea is more largely used,—generally black or mixed; the stronger kinds of green tea used occasionally. I should say the excessive use of tea is more common than that of coffee in this community.

This matter of food and cooking has been one of constant observation with me, and in general terms I can affirm a decided improvement in this community. I am daily impressed with the fact of the growing care with which I can nourish my patients, especially those in typhoid and analogous conditions, and this in great measure is the result of a better appreciation on the part of the people of the need of preparing good food,—broths, soups, etc.

Too much salt meat, especially salt pork, is used in this sparsely settled region; with this exception, the proportions of food are satisfactory. The farms have good vegetable gardens and good means of storage. The modes of cooking are not as good as can be employed. Wheat bread is principally used; corn and rye occasionally. Too much hot biscuit is used. Sour milk bread takes the place of leavened bread. The tea and coffee are judiciously taken in quantity, quality and strength.

[From a tannery town.]

The food is thought to be sufficiently varied, and its proportions are satisfactory; the butcher's meat sold to the working classes is judged to be of inferior quality. The vegetable gardens and the storage for vegetables are good. Wheat bread is most used. Many families use hot biscuit in the morning. Brown bread, hot, is much used at breakfast, and cold for dinner. The bread is not generally well made nor are the modes of cooking as a whole satisfactory. I have come to regard the making of good, wholesome bread as among the lost arts. I believe that fully one-half of American families do not know what *good* bread is, never having seen any. If it be judicious to use tea and coffee at all, those in use here are judicious in amount, quality and strength.

The food in common use is sufficiently varied. Except among the poorer classes, who have an insufficient supply of fresh meat and milk, the proportions of the food are satisfactory. The farms have very good vegetable gardens and means of storage. Wheat bread, and occasionally corn and rye, are used; generally the bread is well made and well cooked. Some families use almost exclusively cream-of-tartar bread, warm or cold. Pastry is not thought to be used as a substitute for bread. The tea and coffee used have not produced any perceptible ill effects.

[From a farming town.]

The food in common use is not sufficiently varied. In most families there is a monotonous routine. From November to April, salt pork and potatoes constitute a large part of the diet of the poorer class. The farms have good

vegetable gardens and good means of storage. Wheat flour bread is used almost exclusively, especially by the Irish; made with cream of tartar. The old-fashioned brown bread is becoming obsolete. Graham flour is but little used; hence the increased amount of constipation and piles. The bread is generally well made and well cooked; but too much of it is eaten in the form of hot biscuit. Pastry is not thought to be used as a substitute for bread. The quantity and strength of tea and coffee are excessive.

The people in this vicinity live pretty well, both as to quantity and quality of food. The proportions of food are as a rule satisfactory; and vegetables are raised abundantly and are well kept. Cooking is not generally what it should be, but is not particularly objectionable. Wheat bread chiefly used; it is well made and well cooked. Pies of all kinds are extensively used as substitutes for bread. Tea is often used to an injurious excess.

In the proportions of food, vegetables are deficient, although most of the farms have good gardens and means of storage. Fresh meats are too often fried. The foreigners (French and Irish) always use wheat flour bread. The natives use wheat flour and mixed. The bread is not well made. The quality of the tea and coffee is generally poor.

[The following letter is from an eminent physician of Boston, who has had every opportunity to become acquainted with the class of patients he describes as suffering from imperfect nourishment.]

I am glad to learn that the State Board of Health have taken up the important matter of the Diet of the People, for I am sure that very great ignorance prevails on the subject. I wish particularly to call your attention to a large class of working people, many of whom are doing their work, as I believe, on very insufficient sustenance,—I mean sewing-women. During my long service as physician to out-patients at the Massachusetts General Hospital, I was very strongly impressed by this conviction. Large numbers of this class,—certainly some hundreds,—consulted me for a train of symptoms which seemed to me very largely due te the simple fact that they did not eat enough substantial food. I could almost tell on the entrance of such a patient what her complaint would be. Let me imagine an interview with such an one, the type of very many which I have had. Enter a well-dressed, highly-respectable looking young woman, without a trace of poverty or privation in her apparel, thin and pallid probably, with a somewhat downcast countenance. In reply to the first inquiry as to her symptoms, the kid-gloved hand is raised to the left breast with a sigh, and "Doctor, I've got a terrible pain in my left side, and think I have disease of the heart." "Why do you think that?" I ask. "Because (with another long sigh), I cannot go up-stairs without my heart beating so that it takes a long time for me to recover my breath." Then follows a long list of symptoms, all more or less connected with great general debility. On further inquiry I learn that this patient works in some one of the large ready-made clothing establishments north of Summer Street, or perhaps in some one of the fashionable millinery stores of that vicinity. Her residence is at South Boston or in the

neighborhood of Dover Street, or south of it,—perhaps at Somerville or Charlestown,—from one to three miles from the scene of her daily labors. As a consequence she is unable to return home for dinner, and remains at her working room all day. She is obliged to rise very early in the morning in order to reach it at the commencement of working hours. As a matter of economy she usually walks to her shop and back, even when her homeward path is weary with the day's labors. Such a person, with the symptoms above described, on being asked as to her appetite, will say, "Oh, yes, I have a very good appetite." "Well, what do you call a good appetite? What did you eat for breakfast, for instance?" "Well, I ate a slice—perhaps two—of bread and butter, and drank a cup of tea." "Do you go home to dinner?" "No, the distance is too great." "What do you eat for dinner?" "Well, I take with me from home some bread and butter, and a piece of cake or pie, and I have the privilege of warming my tea at the stove in the working room," or perhaps of "making some fresh." "Then you take tea with your dinner, do you?" "Oh, yes; I couldn't get along without that." "How much do you take?" "One or two cups." "Strong?" With a laugh, "Yes; I don't like weak tea." "What do you take for supper when you get home?" "Bread and butter and tea." "Don't you get any meat at that time?" "Not often,—living in a boarding-house, it is very inconvenient to have things saved for you from dinner." The conclusion is, that only about once a week does she get a good substantial meat dinner,—on Sunday; for the rest of the time she is kept up to her work by the stimulus of strong tea. I have often heard such persons, when told that they have no organic disease of the heart, and that the first step towards an improvement in their physical condition must be the abandonment of the use of tea, at once exclaim something like this: "Oh, Doctor, I can't do that; tea is my life; I can't do without it!" This tells the whole story. The amount of food taken is entirely inadequate to the amount of work done, and strong tea, by its temporary stimulus, supplies the place of food, until the train of nervous symptoms, which are the natural result, at last drives them to the doctor. This is not the place to discuss the medical treatment of such cases; it is sufficient to say that their improvement is generally rapid under the use of tonics, with a proper supply of nourishing food, and the disuse of tea.

I cannot forego the opportunity to suggest a plan which, it seems to me, would do much to prevent the occurrence of such cases as I have been describing. It is the organization, by benevolent persons, of dining-clubs, for the benefit of sewing and shop women who cannot go to their homes for dinner. If one or more comfortable dining-rooms could be opened by persons of means, in the vicinity of the business part of the city, and a good dinner provided daily for working-women, which they could obtain at cost, I think a great public good would be the result. These could be made as private as might be desired. They might be managed, for instance, as the Thayer Club at Harvard University is, the great point being, through the instrumentality of benevolent people, to provide a dining-room free from the cost of rent to those for whom it is designed, so that the expense of a good, substantial dinner may be reduced to a minimum. I think many a side-ache and heart-ache would thus be spared to a very worthy class of people.

From these letters a fair general view is obtained of the food in common use in Massachusetts. It is not the same in all places, even among corresponding classes. Cape Cod and

Cape Ann differ in this respect from Berkshire and Hampshire. The farmers do not have the same food as the people of the large towns. The Irish, the French Canadians and the Germans have their peculiarities in diet as in other respects, which, however, are soon modified by living among us. The richer and more luxurious class of our citizens, in town and country, have their own style of living. But making all these allowances, it is still apparent that among the million and a half of people in Massachusetts, a great majority have a selection of food which may be regarded in a general way, since it has a distinctive character.

That this is so will be recognized by all who remember whether they are in the habit of eating fish-balls and rye-and-indian bread for breakfast, and baked salt pork and beans, seasoned with pepper and vinegar, for dinner, every Sunday. These dishes are found only here, where they originated, or where New Englanders have carried them.

It is not flattering to our pride to read some of the preceding testimony. But it is consistent with the truest loyalty to our State to examine the question to which it refers, whatever may be the verdict. There are always plenty of people to tell us how intelligent we are, to contrast our institutions with those of other lands to our own great advantage, and to make us feel that we lead the advance in the march of civilization. We hope that this is all true,—but if it should prove that there are great defects in our social system, the sooner we know them the better. No improvement will come until the people are convinced that it is needed.

Bread.

The quality of bread in any nation, community or family is a pretty good measure of its civilization. No one can entirely dispense with it. Good or bad, in some form it must be had. So it is, and has been from the earliest records of our race, and so it will doubtless continue.

Leavened or fermented bread is as old as the time of Moses, and its value has been fairly tested. There are those in these latter days who would have us believe that the leaven plays no useful part, except by the liberation of fixed air to distend the mass, and that this process may be imitated by the use of

various chemicals. A vast experience contradicts them. Whatever be the precise action of the leaven, it transforms the grain by partial decomposition of its original elements, and leaves as its resultant what all men in all ages have approved. The modern substitutes leave resultants which impair the flavor, diminish the nutritive property, and break the staff of life.

Unleavened bread, made by mixing the various grains with water and salt, and baking (usually in thin sheets) is quite another thing, and a form of nutriment with which we have no fault to find, unless it supplants, in the form of crackers, the more legitimate article.

Is the art of making good, honest, leavened, bible bread lost in Massachusetts, as some of our friends declare? One may go up and down the State, as the writer has done, stopping at hotels, railroad restaurants and private houses, and be almost ready to believe it. For a single specimen of bread made with flour, water, leaven or yeast and salt, sufficient kneading and judicious baking, one will meet with fifty at least in which these requirements have not been met. Baker's bread is almost universally mixed with some extraneous substances, alum and carbonate of ammonia being most employed. Bread hastily made in families is mixed in a variety of ways with carbonates of soda or potash combined with phosphate of lime, with cream of tartar, or with sour milk, and is generally imperfectly cooked. Instead of honest bread and sweet butter, their places are supplied in thousands of families by some of the poor substitutes for bread to which we have referred and by butter carelessly made and wanting those savory and nutritious qualities it ought to have, and which are so valuable to young and old.

Very often the elements of wheat and fat* which the body demands are furnished in underdone pastry, made from flour and hog's lard. If our readers think this representation incorrect let them look at the food supplied at railroad restaurants, or other and similar establishments, whose business it is to meet in this respect the demands of the people. Pies and sweet cakes, with coffee, tea and milk are the staple articles in

* A wise and witty Boston clergyman of the last generation used to say, "Bread is the staff of life, but bread and butter is a gold-headed cane."

such places. Baked beans and salt pork can often be had, but very rarely good bread, good butter, or good meat. The first legitimate effect of such constant food as this with people of average condition is indigestion or dyspepsia; the second, is all that train of ailments caused by imperfect nutrition.

As an example of good bread we would mention that which is always to be had at the restaurant of Parker's Hotel in Boston. It is not better than is found on the continent of Europe on all the great lines of travel, and in common use by millions of people in Germany and France; but with us it is a rare example of what bread may be. It is made from a mixture of flour such as is generally sold in our markets, water, salt, and yeast,—and nothing else. The yeast is made from malt, potatoes and hops. The dough is kneaded for from one and a half to two hours, and is then thoroughly baked.*

Any family can have as good bread who will take pains to make it in this way. It involves skill and judgment, in which qualities our housekeepers are surely not deficient. The materials are simple and not expensive. The value of time and labor required for kneading are the only real difficulties, and these we would not undervalue; they are in many families very serious, and not easily overcome. But we can see no reason why in any town or village families may not furnish themselves with good bread by means of coöperative associations, without increasing the present cost of this first essential of wholesome nutrition.

If good bread and carefully made butter were always to be had, the consumption of pies, fried doughnuts, sweet cakes, and such meretricious substitutes would diminish; and as surely dyspepsia with its attendant ills would become less frequent among persons of all ages.

Variety in Food.

The expenditures of the body, whether in heat-making or tissue-making, or thought-making, may be theoretically met

* This information was got from Mr. Mills, and the baker of the restaurant. The materials are mixed in large masses, and therefore the time required for kneading by hand is the greater. It is in vain, however, to expect good bread without long-continued and laborious kneading.

by a fixed diet, but practically they cannot be. Experience has proved to every observing person that, for some reason unknown to science, variety is essential to health after reaching the age when we are free to choose our food. Nature provides milk for the babe, and it is not only sufficient for, but essential to its complete development. But the perpetual recurrence of the same kinds of food, even though their number be considerable, becomes in all subsequent periods of life not only wearisome, but positively injurious. One of the advantages of what is generally known as a "change of air and scene" depends, without doubt, on the concomitant change of diet. Seamen feel this restriction of food on long voyages, and their excesses when ashore may be largely due to this cause.

Our soldiers during the late war, restricted for long periods to the army ration, gratified this longing for a change by every device in their power. Inmates of prisons, poorhouses, and even (we regret to say) hospitals, often loathe their food, and are consequently imperfectly nourished, simply because it lacks variety. Visitors go to these establishments and taste the food, and very likely find it better than they get at home, and wonder why it is complained of. But if they were compelled to eat it every day, in the same inevitable round, the same distaste would follow.

Our correspondence shows that the food of great numbers of our people lacks variety. This is due to many causes, and among them are to be reckoned very prominently, poverty, and the difficulty of buying fresh provisions in places remote from markets. Salt pork, salt fish, and potatoes, with pies and poor bread, or its substitutes made from flour or rye and Indian meal, and Japan tea, are the staples of food in thousands of families during our long winters. But there are others, and they form a very numerous class, whose nutriment is deficient simply because they do not know how needful it is to change it from time to time. It is within the power of every one living in the country to use a great variety of fresh vegetables. The climate favors their production, and but little care is required to keep them in good condition. The edible roots, as turnips, carrots, onions and beets, are as well worth preservation as the omnipresent

potato. Each contains elements of nutrition peculiar to itself, and can add new value to the stronger foods. The same may be said of cabbages, now so extensively used by the Irish in Massachusetts. All these vegetables need thorough boiling, and more than they generally get.

The acid fruits and vegetables, as apples, tomatoes, and rhubarb stalks, need no commendation. They seem to meet an urgent want in the diet of our people; and this want is apparently identical with that which has led to such enormous use of vinegar and pickles, in conjunction with the coarse fat of the pig, which, in the form of lard, enters into almost every preparation of food. Wherever hog's lard and fat salt pork are freely used, there will also be found pickles or vinegar.

The mildly acid tomato, unknown here till within half a century, is now most extensively used. Rhubarb stalks in their season, enjoy an almost equal popularity. Apples, now as always, are to be found in nearly every house. And may the use of each of these valuable forms of food never grow less.

The demand for acids in conjunction with the coarse fats is unexplained by science;—and this illustrates several things. First, the enormous complexity of the operations of nature's laboratory in the process of digestion; second, the unfailing guide which instinct gives us in the choice of the elements of our food, when the body is in a state of health; third, the inexpediency of regulating our diet by theoretical considerations.

The frying of meat is most unprofitable for the eater, however convenient it may be for the cook. It robs the meat of its juices and hardens its texture. The extreme heat of the fat not only burns the outer layers of the meat, so as to injure their value for nutritive purposes, but also changes the chemical condition of the fatty acids; giving rise to products which obstruct the breathing and cause tingling of the nose and eyes of the cook, and which are more or less harmful to the eater. The peculiar flavor of the meat is in a great measure lost by frying, and for it is substituted the flavor of the fat in which it is cooked. This fat permeates the fibres of the meat in such a way as to render them less

soluble in the watery fluids of the mouth and stomach, and thus causes difficult digestion.

It is to be feared that our cooks have a fatal facility in the use of the frying-pan. It is the rudest mode of preparing meat, and so inferior to every other in its results, that we may reasonably hope that the improvement in this respect which our correspondents observe will continue. Broiling on a gridiron over a quick fire costs a little more time and trouble, and very likely fuel also, but by this process the juices of the meat are sealed up (to a certain extent), instead of being evaporated, and the nutritive value thereby much increased. The superiority both of flavor and digestibility which broiled meat possesses are perfectly well known. The general substitution of the gridiron for the frying-pan in the hasty cooking of meats, would be most advantageous to health.

Baked beans and salt pork furnish the chief nutriment of at least two-thirds of the people of this State above the age of infancy, for one day of every week. Experience proves that this is a very nutritious food, strong enough to sustain a man under severe labor; and chemical analysis shows that it is rich in the elements which go to make up the strength of the body.

We have no fault to find with this food when sufficiently cooked (as it generally is in Massachusetts), provided it is eaten by persons in health; but a large minority of people of all ages cannot digest it with comfort, and to others it is certainly injurious. It is a serious deprivation to a numerous class to find their supplies of other kinds of meat than salt pork cut off for one, and very often two days of the week, and this is especially the case when good bread and butter are not to be had. The alternative for beans and pork is too often only heavy, sodden, and equally indigestible pie.

That pork and beans are productive of illness in a certain proportion of persons in average health, we feel well assured, from watching the sick-list in a Massachusetts regiment during the late war.

Pastry and Cakes.

Our correspondents nearly all agree in saying or implying that the consumption of these articles is great. It is indeed

enormous, and constitutes the most marked difference between the diet of the people of New England and that of any other people on earth.

In so far as pies are used as staples, or what the French call "pièces de resistance," and not as additions to more substantial food, they take the place which is in other countries occupied by either bread or meat; we incline to believe it is the former; most of our correspondents think the latter. It makes but little difference. The pies made of chopped meat supply in a certain way two great wants of the body; those made of fruit supply others. But both supplement the food made from the cereal grains, whether wheat, corn or rye.

Pies are eaten twice a day by most people in Massachusetts above the age of five, and if a lunch is called for it is generally pie and nothing else. Country bakers often distribute more pies than they do loaves of bread. On the diet list of factory boarding-houses pies occupy the most prominent and constant place. Pies are the most constantly recurring form of food to the traveller throughout the State.

The average Massachusetts pie (used as a staple of nutrition, and not as an addition to a dinner of meat or fish with bread), is made from flour, and water, and salt, mixed and rolled with "shortening," which consists of the cheapest fat to be found, to which is often added carbonate of soda, or some other of the powders which liberate carbonic acid.

The fat is generally hog's lard, but butter of the lowest grades can often be bought at about the same price, and is either used instead, or is mixed with lard. The cheapest and most inferior butter * which is sold, (so bad that it can hardly be eaten with bread) is thus used for pastry and for cake, in prodigious amounts.

The paste prepared in this way is made to enclose, First, chopped meat seasoned with hog's fat and various spices. The meat, like the butter, is usually of the poorest kind, and such as could be eaten in no other form except sausage. The spices cover the taste of the meat, and whether it be beef, mutton, pork, or veal, no one can tell, or form the least judgment of its fitness for food. Second, apple, peach, huckleberry, and similar small fruits. Third, squash. Fourth, custard.

* Butter in which the fatty acids are freely developed.

We intended to say as little as possible about the physiology of digestion, but the fact that pastry is ill borne by those of feeble stomach is so well recognized that an explanation of the reason may be allowed. All forms of food containing nitrogen (including the gluten of flour) are digested in the stomach. Oils and fats of every kind pass unchanged through the stomach and are digested lower down in the alimentary canal. The close incorporation of the gluten with the fat in the process of rolling pastry (needful to make it light by enclosing the materials which will distend it when heat is applied) renders the action of the gastric juice upon the mass exceedingly difficult. It must, so to speak, pick out from this close union the parts which it is fitted to reduce to a form ready for absorption, and let the remainder pass on.

Badly made new bread, by forming a pasty mass, is also difficult of digestion to many persons, as a similar * discrimination must be made by the stomach between the glutinous and the starchy elements of which it is composed. But new bread when well made and cooked is not open to this objection. The French are the best bread-makers in the world, and eat their bread when freshly made.

Time Devoted to Meals.

The usual or average time occupied in the process of taking food by the people of this State we think does not exceed from twelve to fifteen minutes for each meal.† Such haste is injurious to health for many reasons, to some of which we will refer.

Eating in this manner we do not know when we have had

* The same difficulty in disentangling the elements of which food is made up is observed in the case of oily nuts. The digestive apparatus would have no trouble in disposing of the oil, or the starch, or the vegetable albumen, if they were simply mixed together; but in the natural form of the nut the union is so close as to make the task of digestion an ungrateful one with many persons.

† This opinion will be disputed by many readers. but it is founded on careful inquiry and observation. The operatives in boot and shoe shops, cotton and woollen mills and other industrial establishments, make up a very large proportion of our adult population, and as a class they do not remain at the table more than ten minutes for each meal. Those engaged in active, engrossing business and trade throughout the State, allow themselves but little more time. Out of door laborers, and farmers, with their families, are in less haste. The class who remain a long time at the table are (comparatively) few in number.

enough, and are in danger of taking more than the stomach can properly dispose of.

The appetite for food is only gradually appeased. What hunger really is, or how it makes itself felt, it would, we think, puzzle any one accurately to define, but if we eat slowly, time is given for the system to become aware of the progress of the supply and also of its fitness to remedy the want, and presently there succeeds a feeling of satisfaction, which is nature's signal for ceasing to eat. Deliberation in this constantly recurring pleasure gives opportunity also for conversation, and that light occupation of the mind which greatly assists digestion.

This process of digestion begins in the mouth, with the action of the teeth, and through excitement of the salivary glands by the presence of food. Unless saliva is abundantly mingled with food the first act of digestion is obstructed, and nature's plan is changed. This fluid not only lubricates, but acts chemically* in the mouth, if a reasonable time be given it, upon all the starchy elements which make up the great bulk of what we eat.

Eating in haste a great deal of air is swallowed. Air is to a certain extent always entangled in the saliva and assists digestion, but when the "wads" of food (if the expression may be allowed) succeed each other very rapidly, they seem to act like pistons in the tube (the œsophagus) leading from the back of the throat, and drive before and between them into the stomach such amounts of air as distend that organ and impede its functions.

Nature tries to correct this evil by eructations of wind from the stomach immediately after the meal is thus swallowed, but enough remains to become a source of needless disturbance to the whole digestive apparatus.

Another effect of eating in this way is that the masses of food, imperfectly mixed with saliva, become impacted in the œsophagus, checking its muscular action which is obviously intended to propel only one at a time. This embarrassment

* All starch is converted into sugar before it can be absorbed for the body's use. The chief agent in this conversion is the pancreas, whose secretion is mingled with the food after it has passed the stomach, but the salivary glands begin the process, and ve:y actively.

is overcome by taking, at one gulp, as much fluid as the mouth will hold, thus distending the elastic tube and washing the obstructed food into the stomach. All this is surely unnatural and can hardly fail to work mischief in the course of years.

Dyspepsia is too common a complaint among our people to warrant the overlooking such things, which may seem to many persons to be trivial and unimportant.

Tea and Coffee.

The appetite for stimulants of the nervous system, which in some form is met with wherever man exists, finds its gratification to a very large extent in Massachusetts in the use of coffee and tea.

The quality of both these articles in common use is certainly poor. Our report of last year showed that most of the coffee sold in pound packages is largely adulterated with articles in themselves harmless but which greatly diminish its legitimate effect.

Tea does not fail from this cause. It is strong enough. The difficulty lies in its possession of the nerve-stimulating property in an extreme degree. The kinds in most common use by the people are Oolong, Japan tea and Hyson. Souchong (or English breakfast tea) is increasing in use.

Almost everybody drinks coffee at breakfast and tea at supper. A great majority of the people also drink tea at dinner. Among women, tea is also in common use at other times. The overworked and underfed (or imperfectly nourished) sewing-woman, or factory-hand, or housewife, finds comfort and temporary relief from exhaustion by the stimulus of tea at any time.

Both coffee and tea have properties which are universally recognized as valuable. Without being nutritive (except in an infinitesimal degree) they sustain nutrition by limiting the body's waste, and by promoting the absorption of real food. Without being capable of directly forming the tissues of which we are made up, they make these tissues do extra duty by preventing their absorption and removal. They belong to the class of supplementary foods, and, by common consent, rank among the necessaries of life. But like many other

good things they are liable to abuse. Their healthfulness depends on the amounts taken, and the times when taken. They enliven and inspirit the wearied body, and they make nutritious food go farther. But the nerve-stimulation may be carried to intoxication, and the substitution of supplementary for real food may starve the user. An illustration of the first effect may be found in the third report of this Board, page 129, and the second is explained by examples in the letter which we publish from one of the physicians of the Massachusetts General Hospital.

Our correspondence will be found to make very frequent reference to such abuses of tea and coffee. Tea made by pouring boiling water on the leaves, and drinking the fresh infusion, is a very different thing from tea made by long stewing on the fire. In the one case the aromatic qualities predominate, while in the other the aroma is boiled away, and there remains a concentrated decoction of the *thein* and the astringent matters with which it is combined. Such tea is intoxicating, and taken in considerable amounts, and without food, will produce a condition of body resembling delirium-tremens, and a fretful perversion of temper productive of domestic unhappiness, or even crime. In a less degree the same cause of nervous disturbance is often seen in the over-worked and underfed women employed in great cities, as described by our correspondent in Boston. If instead of relying so exclusively upon the cup which is said (incorrectly as we believe) to "cheer but not inebriate," they would substitute for it at night, when the day's work is over, a cup of beef-tea, they would find it to be a cup which both cheers and nourishes.* This change would be followed by refreshing sleep and improved daily strength. There are many extracts of meat now sold at such prices that this substitution may be made, not for the same money indeed, but at

* We have made the following estimate of the comparative cost to a working-woman of tea, and beef-tea made from the Leibig Extract. Tea being ninety cents a pound, sugar thirteen cents a pound, milk ten cents a quart, and Leibig Extract of meat sixty cents for a jar holding two ounces. Twelve ounces of infusion of common tea (two good sized cups), with milk and sugar, would cost two cents; six ounces of infusion of meat extract would cost four cents. Fuel the same in either case. The above is submitted for the benefit of those who cannot use common tea with moderation, or of those whose nervous systems are disturbed by its use.

an increased cost which is worth paying by a woman whose subsistence depends on the maintenance of health and strength. We will anticipate objections to this recommendation by saying that these "extracts" are not to be compared for a moment to meat itself, and are inferior to freshly made beef-tea. But when it is contended, that they hold no albuminous matter, and are *therefore not nutritious*, we must say that experience in their use proves the contrary. The deficiency of an important element of meat may be supplied, if found needful, by adding the white of an egg after the beef-tea is cool enough to prevent coagulation. The extracts of meat have the very great advantages of cheapness and convenience for use when wanted.

Excessive Use of Water.

Every one must have observed the difference in the requirements of individuals in the use of drinking-water. There are those who drink only at meals, and others who drink throughout the day, at short intervals, in both summer and winter. This depends, no doubt, in a great degree upon differences in temperaments, of skin, and of food, but it is also very much a matter of habit. In our manufactories of all kinds, water (very often iced) is placed within easy reach of every person, male or female, and the effect of this constant invitation is seen in the drinking of what physicians must regard as unreasonable amounts. The food is thereby diluted, and the stomach is oftentimes chilled below the temperature of the blood, and by repeated draughts, may be kept in this condition. The process of digestion is in this way seriously interfered with. A certain amount (70 to 100 ounces) of water is required daily for the nutrition of an average adult; but of this total requirement twenty to thirty ounces are contained in the so-called solid food, leaving about sixty ounces to be supplied in some form of liquid, as tea, coffee, and water. If this amount is greatly exceeded, it forces additional and needless work on the organs of excretion.

We are inclined to believe from what we have seen that young persons employed in our factories very often drink double the amount of water which the body requires, from

mere thoughtlessness, and this habit once established, is likely to continue through life.

Cost of Labor as Influencing Food.

Every one familiar with life in New England will confirm the truth of the statement that the effort to escape the wear and tear of domestic service has greatly modified the food of the people. Our housewives are overworked; they have a great deal to do, and but few hands to help them. In the families of farmers and mechanics, in factory boarding-houses, wherever food is prepared for the working-classes, there is the same constant strain upon nerve and muscle. Indeed, every class among us feels the difficulty of securing domestic service. The rate of wages has risen with everything else, until now it is impossible to hire a woman to cook or attend to any other of the duties of housekeeping for less than three to four dollars a week, with board.

Home-life is discouraged, and people take refuge in hotels and boarding-houses in order that by association their care and trouble may be diminished.

This cost of labor has influenced in a great degree the various kinds of food in common use, and the modes of preparing them. Whatever can be made in one day and kept for use in several succeeding days is preferred. The quickest way to cook fresh meat is to put it in the frying-pan. The laborious kneading of fermented bread is dispensed with, and its substitutes are prepared by the hasty stirring-in of chemical powders.

The traditions of honest bread are not lost to the present generation, but there is too often no one to give the time and labor necessary to make it.

This extreme difficulty of doing the needful work of the household "short-handed" is the direct cause of much apparent carelessness in the preparation of food. And the remedy for this difficulty is not obvious. There is a continual removal of women from home-life to do the work of factories. There is a constantly increasing pressure of population in the towns at the expense of the country, and great activity of every form of manufacturing industry in which young women readily find employment. There are those also who say that the

daughters of our hard-worked housekeepers who stay at home do not help their mothers as they should do; and if this is so, the causes are to be looked for in errors of our social system not easily reached or corrected.

No improvements in the manner of preparing food for daily use stand the least chance of adoption in Massachusetts unless they are labor-saving. The teachings of Professor Blot will never avail with us. We need not only to know how to make nice and palatable and wholesome dishes, but how to make them with the least possible expenditure of labor and of time.

This labor-saving principle must be the basis of all amendments, whether as regards fuel, cooking-utensils, coöperative associations, or whatever direction they may take. Whoever can show us how to produce, with the same materials of food, better results with diminished labor, will have done invaluable service; and no one need fear that their efforts, if successful in doing this, will be unappreciated. Never was a people before seen on the earth so ready to welcome improvements of every kind, and even in this province of dietetics, where conservatism is most unrelenting with most nations, real improvements would be well received.

The inventive faculty, so active in other directions, has never made much progress in turning to the best account the abundant food which we have. Its preparation is too often regarded as unmitigated drudgery, and not as a department of art whose cultivation may make our lives more healthy, useful and happy. A great deal of excellent food is wasted in our kitchens. Good flour is turned into various forms of cake which makes a show of variety on the table, but much of it, becoming dry or mouldy, is finally cast away.

Bread in various forms may also be seen in very considerable amounts in the refuse which goes to the pigpens; and bones with adherent meat capable of making excellent soups, take the same unprofitable direction. But the cooks are not alone to be blamed for these short-comings. Eating and drinking are not appreciated. The average Massachusetts man or woman, having a hard battle with life, engrossed with bodily or mental toil, has never seemed to regard food except as fuel for the human furnace; demanding only as good muscle or brain-making fuel as can be got, to be taken in at

regular intervals, and at any rate to be despatched with as little delay as possible.

This neglect of what seems to have been designed not only for our bodily but mental refreshment, coincides with our indifference in the past to Art in every form, painting, sculpture, architecture and music.

This great deficiency in what is needed to make our lives harmonious and complete is not to continue always. There are signs of improvement in all directions. Already we seem to be advancing rapidly in an appreciation of some of these refinements of life, and others will surely follow. There are special difficulties, to which we have referred, in the improvement of food and its preparations, which will make progress slow in this direction, but it will surely come. When bread, the staff of life in all countries, is found to be as good in Massachusetts as in Europe, it will be a sign that the point at which we should aim has been reached.

A REPORT

ON

THE ADULTERATION OF MILK.

BY

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ASSISTED BY

PROFESSOR JAMES F. BABCOCK.

THE ADULTERATION OF MILK.

The very great extent to which the adulteration of milk is avowedly practised in our large cities is becoming more and more a subject of general and just complaint. Although sixteen years have now elapsed since the necessity of legislative interference was recognized in this State, and statutes were framed ostensibly for the purpose of exercising, or inducing the local authorities to exercise, a supervision over the sale of this article, there exist strong reasons for believing that these measures have been to a great degree inefficient or inoperative; that they fail to afford to the public that protection from imposition which they are supposed to offer; that although they sometimes bring to light the more gross and flagrant cases of sophistication, they fail to strike at the great mass of petty offenders, whose adulterations, from the fact that they are carried on more ingeniously and systematically, present more formidable obstacles in the way of detection.

And why are the laws that have been framed inefficient? The solution of this question is to be found in a variety of circumstances connected partly with defects, or deficiencies, in the statutes themselves, and partly with the apathy and indifference which prevails on the part of the public, who fail to recognize the real character or magnitude of the evil. It may be laid down as a general principle, that no offence will, in the estimation of the public, be regarded as a very heinous one, which is not visited with some pretty severe penalty; for it is indeed difficult to regard any misdemeanor as very serious, if it be leniently dealt with, or tacitly allowed, by the existing authorities. The skimming and watering of milk—the darkest feature of which is the increase in the rate of infant mortality thereby caused—should be stigmatized as a grave crime; and the offender, when dragged to light, should be subjected to to some severer penalty than a paltry fine. Once let it be

understood that the perpetrator when detected shall be subjected to some ignominious punishment proportionate to the offence,—shall be, for instance, imprisoned in the house of correction,—in that case a different moral standard will at once be created, and what is now considered as a trivial misdemeanor, will henceforth take rank among the unpermissible as well as forbidden offences.

Again, the law is rendered inoperative by the presence of the mischievous and erroneous idea, that a very great variation exists in the quality of pure milk; and hence, unless a suspected sample is proved to fall *very far* below the normal standard, it is not easy to convince the juryman that beyond all doubt adulteration has been practised. At other times, when the chemist affirms upon oath that the specimen in question has been adulterated with twenty per cent. of water, the correctness of his standard of comparison is called in doubt by the opposing counsel, inasmuch as this standard is taken from foreign authorities. The jury are gravely assured, that the richness of the milk depends upon the character of the food furnished to the cow; and it is unreasonable to expect that as rich a milk should be demanded from a cow raised upon the sterile soil of Cape Cod, as is yielded by the highly-fed animals of England. It is conceivable that such representations would have their effect upon the average juryman, and hence lead to the acquittal of the accused. This popular fallacy might be easily eliminated by a chemical investigation of the milk produced under different circumstances in different parts of the State,—an investigation which thus far has not been undertaken.

The indifference of the public on this subject, has, moreover, its origin in part in the conviction that this fraud is one which cannot be successfully attacked by any individuals, or bodies of individuals, however powerful or determined they may be, but that it can only be suppressed by the interference of government; and that in this, as in other matters relating to sanitary reform, the duty rests with the State to throw so many obstacles in the way of the perpetrator, that it cannot be undertaken without incurring the danger of detection and appropriate punishment.

Still another cause for the apathy of the public in tolerating

this very general deception, is the fact that it is a somewhat humiliating circumstance to acknowledge one's self to be the victim of roguery in a matter apparently so simple; so that each consumer, though he may betray a remarkable tendency to credulity with regard to the sophistication of milk in general, consoles himself with the idea that in his own case the genuine article is supplied.

It is proposed in this paper to consider briefly, for the benefit of those who may not already be familiar with the subject, the various methods which are resorted to—or which are popularly supposed to be resorted to—for the purpose of adulterating milk, and the means which have been afforded us by chemists for their detection; to review the principal legislative enactments which have been framed for the purpose of extinguishing fraud in the sale of this article; and, last of all, to advert to the principle of the measures upon which, in our opinion, any attempt at improvement in these laws should be based.

It will perhaps conduce to a better understanding of the subject, if we, first of all, review the constituents of genuine milk, and some of the methods of examining it, and the normal variations to which it is subject.

A.

The Composition of Milk—its Variations.

Genuine milk is composed of water, holding, either in suspension or solution, fat globules, casein or cheesy matter, sugar and various mineral matters or salts.

It is a physiological fact, well known to dairymen, that the quantity and quality of milk yielded may vary somewhat, not only in different cows, but in the same cow, this variation depending upon,—

1st, *The breed of the cow from which it is obtained.*—The milk of certain cows, particularly the Alderneys, contains a very large proportion of cream, and therefore forms a very nutritious food for infants; while the milk of some other races, such as the Durhams, is richer in casein, and is on this account especially adapted to the production of cheese.

2d, *The number of calves which the cow has borne.*—Less milk is given with the first calf than with the subsequent ones.

3d, *The time that has elapsed since the last calving.*—During the first week or ten days after the birth of the calf, a yellow, thick and stringy milk, called colostrum, is secreted, which is unfit for use.

4th, *The character of the food furnished to the animal.*—Although the chemical constituents of the milk are not much affected by the food consumed, provided the food contains an equal amount of nutritious matter, yet it has been determined by careful experiments, that when cows are fed principally on carrots, there is a slight diminution in the amount of casein and butter, and an increase in the quantity of sugar; and this change becomes still more marked when beet-root is made the chief article of diet. On the other hand, the food furnished may not afford a sufficient amount of nutriment, in which case a diminished quantity of milk is secreted; or again, the food may be of an unnatural character, such as distiller's grains, in which case the milk-producing organs are unnaturally stimulated, and a large amount of deteriorated milk is yielded. If the food consists of the refuse of distilleries, then the animals become extensively diseased, and although the appetite remains unimpaired, the milk given is manifestly unfit for consumption, and its sale has been very properly condemned by legislative enactments. The yield of milk is most abundant in spring. In dry seasons the quantity secreted is less, but the quality is richer. An unpleasant taste and odor is said to be imparted to milk by an exclusive diet of turnips or oil-cakes. It is also similarly affected by certain weeds or leaves of plants, which are eaten by the cattle in dry seasons when the pasturage is bad.

5th, *The care and attention that is bestowed upon the animals, and the ventilation and cleanliness of the stables in which they are kept.*—Instances, illustrating the effect of neglect in this respect, are common, in which an exceptionally rich milk, having a high specific gravity, and yielding a large per cent. of cream is so thoroughly impregnated with the vitiated air of the stable as to be decidedly repulsive to the taste.

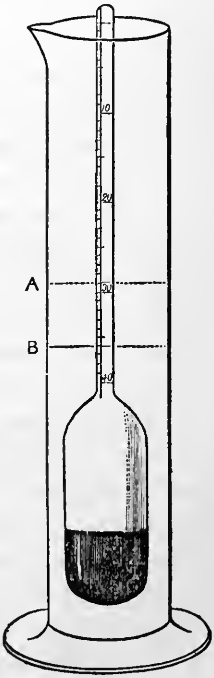
6th, *The time of milking.*—It is well known that the quality of milk from the same cow varies with the time of

milking, the afternoon milk being richer on the average by one-fourth than that obtained in the morning, and the last portion of a milking (known as the strippings) being the richest and often reserved, therefore, for cream.

B.

Methods of Examination.

A number of instruments have been employed, with the object of affording some simple method by which an approximate idea of the quality of milk may be obtained, without resorting to an elaborate chemical analysis. These are:—1. The hydrometer and centesimal galactometer, which are both specific-gravity tests. 2. The lactometer, or cream-test of Sir Joseph Banks. 3. The lactoscope. 4. The microscope.



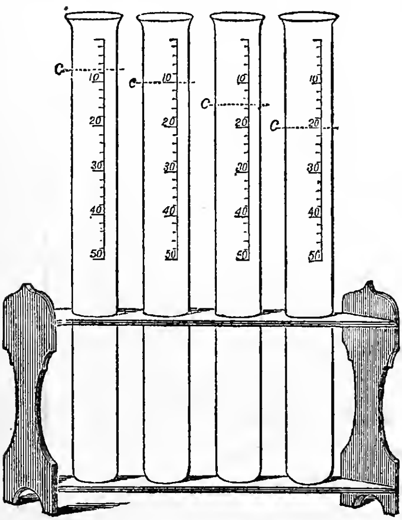
1. The Hydrometer.*

1. *The hydrometer.* This instrument alone affords an imperfect and often fallacious test of the richness of a specimen, and for the following reasons:—*First.* On account of the variation in the specific gravity of different samples of genuine milk. *Second.* Although, as a rule, milk which is rich in cream is also rich in the other fixed constituents, yet samples may undoubtedly be found which are very rich in cream, but poor as regards the other constituents, in which case the richness would be in an inverse ratio to its density. *Third.* The specific gravity of impoverished milk may be fraudulently lowered, or raised, by the admixture of various ingredients, particularly water and salt. The ordinary specific gravity of pure milk at 50° Fahrenheit ranges between 1,029 and 1,037, and it is no secret to milkmen that this specific gravity is not much changed if four per cent. of water be added for every one per cent. of cream abstracted.

* *A, B,* the range of genuine milk.

The centesimal galactometer of M. Dinocourt is designed to determine the purity of milk in precisely the same way as the hydrometer,—that is, by measuring its specific gravity. It possesses one advantage over that instrument, in that it indicates with greater accuracy the degrees.

2. The instrument known in England as the lactometer, or creamometer, is simply a long tube graduated into a hundred parts, and intended to indicate the percentage of cream which has spontaneously separated from the milk, and risen to the surface within a given time. This quantity generally measures from eight to twenty per cent., and, in certain breeds of cows, may amount to even fifty per cent. The lactometer, of course, affords no knowledge of the other constituents, such as the casein and sugar, which, in some instances, may be contained in large quantities in a sample which is not rich in cream.



2. The Lactometer of Sir Joseph Banks.*

It may be mentioned here that an instrument called a lactometer is employed in Boston, constructed upon the same principles as the hydrometer, and carried by most milkmen. This instrument indicates, upon a scale of twenty degrees, the variation between pure milk and water.

Now, if the sophistication in any given sample has been limited to the removal of cream, and the addition of water, the combined employment of the hydrometer and lactometer, subject to certain precautions (such as noting the temperature, the time the milk has stood at the period of observation, &c.), will afford a pretty fair knowledge of its character; for the effect upon the specific gravity of the addition of water is quite as marked as its influence upon the proportion of the solid constituents. This method of examination (known

* *c, c, c, c,* indicate the percentage of cream in four different samples.

in Europe as that of Müller) has been adopted in the law-courts of Switzerland, in settling all questions as to the purity of any sample; and from it there is no appeal. It is fallacious, however, inasmuch as it fails to take into account the fact, familiar to our accomplished milk-venders, that the effect upon the specific gravity of the addition of water may be entirely neutralized by the addition of certain other substances, particularly salt.

3. *The Lactoscope.*—This instrument is intended to determine the richness of milk by measuring its opacity, its operation being based upon the fact, that while the fat globules are opaque, the liquid in which they float is nearly transparent. It follows from this that the transparency of any sample is in inverse ratio with its richness, and the more water it contains, the thicker will be the layer through which rays of light from the flame of a candle, placed at a given distance, are transmitted. The percentage of fat globules may be read off upon a scale attached to the instrument. The original lactoscope was invented by M. Donné, and was favorably reported upon by a committee of the French Academy of Sciences, to whom it was referred for examination. Although it has since been improved and simplified by M. Vogel, it is not thought to present any important advantages over the lactometer.

4. *The Microscope.*—This instrument, like the lactoscope, affords a comparative idea of the richness of milk, by enabling us to estimate with the eye the number of fat globules a sample contains. By its aid, also, many of the abnormal constituents, or added ingredients may be made out, such as the casts of the lacteal tubules and pus cells, found in the case of diseased animals, starch, chalk, colostrum, as well as the infusoria and fungi which abound in milk that has stood for several days.

C.

Methods of Adulteration.

It is fortunate for the public that the practicable methods for systematically tampering with milk are exceedingly

limited, and by no means difficult of detection. It is obvious that whatever agent is employed for this purpose must fulfil certain conditions, or otherwise its presence will become patent to even the ordinary observer. Thus, it is essential that any substance added to milk for the purpose of adulteration should be perfectly soluble in the milk, for otherwise it would either rise to the surface, or else be precipitated to the bottom of the vessel in the form of a sediment. It is, moreover, important that the substance employed should not become coagulated upon boiling, nor possess any peculiar taste, odor or color which would be communicated to the milk, and thereby modify or interfere with its conspicuous and well-known properties, and thus betray the sophistication. Now the substance which best answers these indications is water, and there is, therefore, a *primâ facie* probability that this will be the agent generally chosen for this purpose, and that any other substance added will be employed with the design of concealing the effects produced by the admixture of water, with the single exception of carbonate of soda, which is added rather with the idea of preserving milk. The principal substances, then, which are employed, or which are popularly supposed to be employed, in the sophistication of milk are the following:—

WATER.
FLOUR, OR STARCH.
GUM-ARABIC, OR DEXTRINE.
CEREBRAL MATTER.
CHALK OR WHITING.
TURMERIC, OR ANNATTO.
GUM TRAGACANTH.
CARBONATE OF MAGNESIA.
ARROWROOT.
SUGAR.
EMULSION OF ALMONDS, OR HEMP-SEED.
CARBONATE OF SODA.
EGGS.
SALT.

a. Water.—The effect of the admixture of water upon milk is, as has already been remarked, to lessen the specific gravity of the milk, so that an approximate idea may be obtained of the amount of water in any given sample, by measuring the density of either the milk, the skimmed milk or the serum. Thus, if one-fourth of a specimen is made up of added water, the hydrometer would then indicate a proportionately lower density, *e. g.*, if the sample originally possessed a specific gravity of 1,031, it would now measure

but 1,021. A better basis of measurement, however, is afforded by the skimmed milk, or by the serum. The variation in the density of different samples of pure milk is influenced chiefly by the amount of fatty matter and casein present. Now, if a few drops of acetic acid are added to the milk, these two constituents may be coagulated and removed, and in the serum which remains behind we have a factor, which in different specimens of pure milk admits of but little variation, and furnishes therefore a means of tolerably accurate measurement. The effect upon the serum of the addition of various portions of water, according to Hassall, is shown by the following table :—

Serum containing Percentages of Water.	Specific Gravity.
Pure serum,	1,029
Water—10 per cent.,	1,025
20 "	1,022
30 "	1,020
40 "	1,017
50 "	1,014

A standard of comparison is obtained from the examination of a large number of samples of known purity, by which the range of variation is ascertained. Having learned the specific gravity of the serum, and the quantity of cream present, we can form a tolerably accurate estimate of the richness of any given specimen. One source of error must however be guarded against, which arises from the fact that if sugar or salt has been added to the milk, the specific gravity may be thereby raised several degrees. The quantity of water added to a specimen may be also estimated indirectly, by determining quantitatively the amount of the solid constituents or of the milk-sugar present.

b. Flour, or Starch.—The presence of flour, or starch, may be detected by adding a few drops of the tincture of iodine to the whey of the suspected sample. If this produces the characteristic blue color, it indicates that some amylaceous substance has been added. The presence of starch may be

also made out by means of the microscope. In one or two instances, suspected milk which has been subjected to chemical analysis by Mr. Faxon, the milk-inspector of Boston, has been found to be adulterated by the addition of corn-starch.

c. Gum-arabic, or Dextrine.—The expense of this substance, and the fact that it cannot have much effect upon the density of milk, both tend to render its use for this purpose impracticable. It is detected by adding a small quantity of alcohol to the whey of the suspected sample. A dull, abundant, white precipitate falls, which may be proved to be gum by its properties, and which differs essentially from the light-bluish and diaphanous flakes which alcohol produces in pure milk. (Normandy.)

d. Cerebral Matter.—The statement that any such villainous mixture as the *brains* of sheep, or of other animals, is ever employed for the purpose of counteracting the blue tinge, or increasing the density of impoverished milk, is to be received with hesitation. This substance, if present, would speedily settle to the bottom of the vessel, and its true character could then be made out by the aid of the microscope.

e. Chalk, or Whiting.—It is not uncommonly asserted, and believed, that this substance is sometimes added to soured milk to neutralize its acidity. That any such crude adulteration is ever resorted to in this vicinity is highly improbable, for chalk, being insoluble in milk, would form a sediment, and thus lead to inevitable exposure. The addition of a drop of acid to such a sediment would cause effervescence.

f. Turmeric, or Annatto.—These substances are said to be used for the purpose of restoring the rich cream color to deteriorated milk. Their presence is determined by evaporating a portion of the suspected sample to about one-eighth of its original bulk, and then adding a small quantity of caustic potash, when the yellow color becomes brownish, if turmeric has been added, or a bright red in the case of annatto.

g. Gum Tragacanth, Carbonate of Magnesia and Arrow-root.—These agents are also said to be employed, for the purpose of adding to the consistency and counteracting the blue tinge of watered milk. The former is detected by boiling the milk and leaving it to rest for some hours, when a gelatinous deposit is found, if gum tragacanth is present. If this deposit is washed with a small quantity of water, and then tested with a few drops of the tincture of iodine, the characteristic blue color will be produced, on account of the presence of the starch contained in the tragacanth. Arrow-root is detected by means of the microscope, by which instrument the round particles of carbonate of magnesia can also be made out. The latter will be found to disappear upon the addition of a drop of acid.

h. Sugar.—This is known to be extensively employed, in the form of caramel or brown sugar, to add to the color and develop the flavor of impoverished milk. For this purpose a very small amount is all that is requisite, so that it cannot have any great effect upon the density of a sample. Its presence is ascertained by mixing a little yeast with the serum of the sample, and exposing the mixture to a temperature of between 70° and 80° Fahrenheit. An abundant and rapid disengagement of gas will take place in the course of two or three hours, which is a sure sign of the presence of sugar, for pure milk cannot ferment within so short a time, nor is the fermentation ever brisk or tumultuous. (Normandy.)

i. The Emulsion of Almonds, or Hemp-seed.—These substances are expensive, and fail in every particular to fulfil the conditions of successful adulteration. Hemp-seed would impart an unpleasant flavor to the milk, while the milk of almonds would cause it speedily to coagulate. Both substances would render the fat of milk so fluid that it would be impossible to convert it into butter, or the butter, if formed, would be of a very slight consistency. Moreover, the addition of a few drops of amygdaline to an ounce of milk containing milk of almonds, would cause the development of the odor of bitter almonds.

j. Carbonate, or Bi-carbonate, of Soda, is sometimes added in small quantities to milk, to prevent it from turning sour, and milk thus treated is said to retain its sweetness for eight or ten days. When this substance is present, there is a slight increase in the quantity of the incinerated ash, and this ash will moreover be found to effervesce upon the addition of an acid. Other more elaborate tests are given by Normandy.

k. Eggs.—The admixture of eggs is one of the more harmless methods of improving the appearance of milk, not unfrequently resorted to in France. If any considerable portion of either the white or yolk of eggs were added to milk, its presence would be made apparent by the formation of diaphanous clots upon boiling, owing to the coagulation of the albumen of the egg. When the quantity added is very small, however, its detection by this test is difficult, inasmuch as milk in its normal state contains some albumen. It is then necessary to filter the suspected milk and boil the serum. The number of flocculi which form are then to be compared with the number produced in the serum of pure milk, which has been subjected to the same process.

l. Salt.—This substance is understood to be used pretty extensively, with the object of increasing the density of impoverished milk, and at the same time developing its flavor. Its presence is not to be detected by the ordinary observer, but is made manifest to the chemist by the weight and taste of the ash.

D.

Examination of Specimens of Milk Sold in Boston and Vicinity.

To demonstrate by accurate examination the actual extent to which the adulteration of milk is carried, is not within the scope of this inquiry, nor indeed is any such extended investigation necessary, considering that the fact of this adulteration is universally conceded.

The following statement of a physician, one of the correspondents of the Board of Health, affords some evidence on

this point, and the correctness of this statement has been virtually admitted by all who have thus far been approached on the subject:—

"The town in which I live is largely interested in the production and sale of milk, and with pretty good opportunities for judging, I doubt if *five per cent.* of the milk sold in Boston and vicinity is unadulterated when it reaches the consumer, from whatever part of the Commonwealth it may be obtained. It is skimmed, and adulterated with water, burnt sugar and salt, none of which ingredients are very deleterious, perhaps, but if the nourishment of young children in the cities is made up largely of this mixture, it will serve, in my opinion, to account for the increased rate of mortality which is referred to in the following extract from the report of the consulting physicians of Boston, in 1870:*

"'In 1868, the last year of which the records are published, four hundred and eighty-seven deaths from *cholera infantum* occurred in Suffolk County, while in an equal population outside the city limits, the number was less than one hundred. The mortality from all bowel diseases of children is in similar proportion in Boston and in the country.' *Children in the country have pure milk as it comes from the cow.*"

That this testimony, which, it is true, is of a derivative or secondary character, may not rest unsupported by direct evidence, a number of samples have been taken at random and submitted to the analysis of Prof. J. F. Babcock, who, being the official analyst to the city of Boston, has had an extensive experience in the examination of milk. It should be observed, that these samples were in each instance obtained from most respectable milkmen or grocers, and were all sold as pure and at the highest price. In no case was there any previous reason to suspect adulteration. The samples examined, though limited in number, confirm, so far as they go, the statement of the correspondent above quoted, and will serve to illustrate the fact, which milkmen do not hesitate to admit, that, in conducting the milk-trade of our large cities, *adulteration is the rule.*

Report of Analyses by Prof. J. F. Babcock.

A. H. Nichols, M. D., *Dear Sir:*—I enclose the results of my analyses of several samples of milk made at your request, with a view of ascertaining the quality of milk sold by some of the most reputable dealers in Boston, and the detection of adulterations, if any existed.

* See Second Report State Board of Health, page 57.

The material best adapted, and universally used, for the adulteration of milk, as you are doubtless aware, is *water*, with the addition in most cases of a little carbonate of soda, to prevent souring, common salt or sugar, to increase the specific gravity, and thus mislead those who may attempt to judge of the richness of the sample by the hydrometer test; and finally burnt sugar, annato or other coloring, to impart a rich color and overcome the blue tinge produced by watering the milk.

Salt, soda, sugar or coloring matter, being easily detected, and present only in small quantities, the examination of milk for adulterations practically resolves itself into the determination of the amount of water intentionally added, or rather the amount of pure milk and of added water in one hundred parts of a given sample.

Among the various methods which have been proposed for the analysis of milk for the detection of added water, there are two which I have found to give more reliable results than any others.

These are :—

1. The estimation of the amount of solid constituents in the milk.
2. The estimation of the amount of sugar of milk contained in 1,000 parts of the serum.

By comparing the amounts of solids or of sugar contained in any sample, with the amounts of each present in pure milk, we may obtain an approximate estimate of the amount of water added.

Pure milk being variable in quality, we have no absolute standard of purity with which we can compare any given sample, and therefore the analysis of milk for added water is at best only an approximation; but the chances of error in any analysis are all in favor of the milkman, and an examination of milk by either of these methods will, as a rule, give less adulteration than the actual amount.

The various analyses of milk given in the works of Hassall, Normandy, Miller and other standard authorities, being the results of examinations of milk produced in foreign countries, it was deemed desirable to ascertain the average quality of the milk produced in the vicinity of Boston.

For this purpose seven samples of known purity were obtained, and submitted to analysis, the results of which are given below. Great care was exercised in procuring these samples, in order that they might represent milk, not of extra, but rather below the average quality.

All the samples are those of milk raised to be sold in Boston, and were procured from cows not remarkable for the superior qualities of the milk furnished. Analysis A represents milk sold by a milkman—himself a producer—to his regular customers in Boston.

B is milk furnished daily by a producer to a physician of this city. C, D, E are samples of milk procured from a large dairy near Boston. F and G are samples of milk from cows fed on brewers' grains and salt hay, a diet which is well known produces milk of only medium quality.

Analyses of Seven Samples of Milk of known purity, produced and sold in Boston and Vicinity.

	Specific Gravity.	Cream in 24 hours, in 100 parts by volume.	Solids in 1,000 parts by weight of Milk.	Milk-Sugar in 1,000 parts, by weight, of Serum of Milk.	Ash in 100 parts by weight of Milk.	Water in 1,000 parts by weight of Milk.
A, ...	1032	11.0	144.2	55.8	–	855.8
B, ...	1034	8.5	148.1	55.5	1.08	851.9
C, ...	1033	7.0	142.8	54.8	0.74	857.2
D, ...	1035	8.0	143.2	55.2	0.70	856.8
E, ...	1033	9.5	137.1	55.3	0.88	862.9
F, ...	1033	9.0	148.0	55.1	0.94	852.0
G, ...	1036	11.0	147.2	55.3	0.82	852.8

H. Analysis of Milk from a Cow kept for the superior qualities of the Milk furnished.

Specific gravity,	1035
Cream, per cent.,	24.
Solids, in 1,000 parts milk,	181.6
Sugar, in 1,000 parts serum,	56.2
Water, in 1,000 parts milk,	818.4

Average composition of these Samples—omitting H.

Specific gravity,	1033
Cream, per cent.,	8 to 9
Solids, in 1,000 parts milk,	145.5
Sugar, in 1,000 parts serum,	55.3
Ash, in 100 parts milk,	0.86
Water, in 1,000 parts milk,	854.5

Several samples of milk sold by dealers in Boston were then obtained and submitted to analysis, to ascertain how such milk compares with that known to be pure. The specimens were procured from first-class grocers and milkmen who were supposed to deal in pure milk. Twelve samples were examined, and as will be seen by the results given below, ten were more or less adulterated.

Analyses of Twelve Samples of Milk obtained from various Dealers in Boston.

Sample No. 1.—Milk delivered to a private family at the South End.

Specific gravity,	1028
Cream, per cent.,	9.
Solids, in 1,000 parts,	120.9
Milk Sugar, in 1,000 parts whey,	45.

In this milk salt and caramel were detected.

Approximate Composition.—Pure milk,	. . . .	85
Added water,	. . .	15
		100

Sample No. 2.—From a *first-class* grocer, Boston Highlands.

Specific gravity,	1022
Cream, per cent.,	7.
Solids,	114.
Milk sugar,	39.

This sample has been deprived of a part of its cream, and contains *caramel, salt* and *bicarbonate of soda.*

Approximate Composition.—Pure milk,	. . . .	75
Added water,	. . .	25
		100

Sample No. 3.—Sold as *milk from one cow.* Delivered to a private family at the South End, January 9, 1872.

Specific gravity,	1031
Cream, per cent.,	9.
Solids,	112.
Milk sugar,	42.

Considerable *caramel* and *brown sugar* were discovered in this sample.

Approximate Composition.—Pure milk,	. . . .	80
Added water,	. . .	20
		100

Sample No. 4.—"*One Cow's Milk.*"—From the same milkman as Sample 3, delivered upon the following day, January 10, 1872.

Specific gravity,	1031
Cream, per cent.,	9.
Solids,	127.
Milk sugar,	49.

Salt and *caramel* were detected in this milk.

Approximate Composition.—Pure milk,	. . . .	90
Added water,	. . .	10
		100

The analyses of these two samples of "*One Cow's Milk,*" illustrate the care taken by the milkman that the specific gravity shall be such as not to excite suspicion. A hydrometer introduced into each of these samples would indicate "pure milk," and of the same quality, whereas analysis shows that neither is pure and that one has double the amount of added water contained in the other.

The milkman, when requested to furnish better milk, expressed a cheerful willingness to have the contents of his cans "tested,"—of course, by the hydrometer, (or lactometer, as it is here called,)—and was found to be actually provided with such an instrument, by which he could "demonstrate" the purity of his milk.

Sample No. 5.—Milk sold at a grocery in South Boston.

Specific gravity,	1030
Cream, per cent.,	13.
Solids,	101.2
Milk sugar,	42.

Caramel was detected in this milk.

Approximate Composition.—	Pure milk,	75
	Added water,	25
		100

It will be seen that the amount of cream in this sample is greater than in most of the others, yet the adulteration is also great. This is of frequent occurrence, as cream rises from diluted milk with much greater facility than from that which is pure. In a diluted milk, at the expiration of twenty-four hours nearly all the cream will have risen to the surface, while in pure milk, even after it has remained standing for several days, the cream still continues to rise. This will explain how persons who are supplied habitually with watered milk, often consider it purer than the genuine article, because it gives, *apparently*, more cream.

Sample No. 6.—Milk delivered in Boston by a milkman, to a private family at the South End.

Specific gravity,	1030
Cream, per cent.,	8.
Solids,	118.
Milk sugar,	47.

Approximate Composition.—	Pure milk,	85
	Added water,	15
		100

Sample No. 7.—Milk sold by a first-class grocer near Boston Common.

Specific gravity,	1030
Cream, per cent.,	4.
Solids,	128.
Milk sugar,	48.

Approximate Composition.—	Pure milk,	90
	Added water,	10
		100

This milk had been deprived of a greater portion of its cream.

Sample No. 8.—Milk delivered by a milkman at South Boston.

Specific gravity,	1031
Cream, per cent.,	9.
Solids,	124.2
Milk sugar,	47.5

Caramel and *salt* were found in this sample.

Approximate Composition.—Pure milk,	90
Added water,	10
	100

Sample No. 9.—Milk from the *Massachusetts General Hospital.*

Specific gravity,	1031
Cream, per cent.,	6.
Solids,	129.
Milk sugar,	49.

This milk had been skimmed and watered.

Approximate Composition.—Pure milk,	90
Added water,	10
	100

Sample No. 10.—Milk from the *City Hospital, Boston.*

Specific gravity,	1026
Cream, per cent.,	8.
Solids,	115.
Milk sugar,	42.

This sample contained *caramel.*

Approximate Composition.—Pure milk,	80
Added water,	20
	100

Sample No. 11.—Milk delivered to a private family in Charles Street.

Specific gravity,	1034
Cream, per cent.,	8.5
Solids,	148.1
Milk sugar,	55.5

This sample was genuine.

Sample No. 12.—Milk sold to a private family in Columbus Avenue.

Specific gravity,	1031
Cream, per cent.,	14.
Solids,	143.5
Milk sugar,	55.9

This milk was pure.

From these results it appears that out of twelve samples subjected to examination, *ten* were more or less adulterated with water; that *six* were also adulterated with *caramel; four* with *salt; one* with *bicarbonate of soda*, and *one* with *brown sugar*. It is worthy of notice that the hydrometer alone would indicate that all but samples Nos. 1, 2 and 10 were of fair quality of pure milk. In fact, this instrument, which is reasonably accurate where water alone has been added to the milk, is quite unreliable where there has been an admixture of other ingredients, such as salt, sugar, &c. Indeed, it is well known that milk-dealers who are in the habit of watering their milk, do it in a scientific manner, "testing" it by means of the hydrometer, till, according to this instrument, it corresponds to mark of "pure."

In none of the samples examined was there any chalk, starch, gum, sheep's brains or other substances, so often asserted to be present in milk. These analyses confirm, moreover, the result of several hundred examinations made for the city of Boston, which indicate that nothing actually deleterious is added to milk,—water, sugar, salt, soda, &c., being as harmless adulterants as could possibly be used. The word "deleterious" must, of course, be understood to be here employed in a limited sense, for the testimony of physicians goes to show, that where the attempt is made to bring up a delicate child upon a deteriorated milk, such a child may be directly injured, and even starved, by the unnutritious character of its diet.

Yours respectfully, JAMES F. BABCOCK,
Analyst to the City of Boston.

BOSTON, January 13, 1873.

It is but fair to mention, that at the time the above analyses were made, the daily quantity of milk brought into Boston fell considerably below the usual supply, and it is therefore probable that the milkmen, finding it difficult to supply the wants of their customers, added more than the usual proportion of water to their cans. These analyses, then, though they are not to be considered as representing the average quality of the milk distributed by the best dealers, will serve none the less to illustrate to how great an extent sophistication may be carried, without even awakening any suspicions on the part of the consumer.

The experience of the Boston inspector, Mr. Faxon, has shown that the degree of adulteration is in a measure governed by the relation between the demand and the supply. During the early summer, before the wealthier classes have retired to

the country, milk is more freely used, both as a beverage and also in the form of ice-cream and other articles of food. Moreover, at this sea on milk cannot be kept for so long a time. Hence, though the supply is large, it not unfrequently falls far short of the demand, and water is then resorted to in order to supply the deficiency. At other times the supply may be reduced by a prolonged drought, and the consequent difficulty of finding the usual amount of fodder for the cattle.

The greater portion of the milk sold in our large cities is brought in by steam-cars from the country towns, and is handled by four or five different parties in the course of its passage from the dairy to the consumer. It is customary for the farmer or producer, to bind himself to supply to the contractor, at a fixed price, a certain number of cans * each day for a period of six months, beginning either with the first of April or October. The price per can, at the farmer's door, has been for the past few years from thirty-three to forty-two cents in summer, and about forty-five cents in winter. The contractor, or his agent, gathers up the cans left at the different stations by the farmer (or in the larger towns by the collector, who is employed to transfer the cans from the farmer to the station), and under his charge they are transported in a car provided for that purpose to the depots in or near the city. From these depots the cans are taken by the milkmen, by whom the milk is sold at retail to private families, or distributed among the grocers. The prices obtained by the contractors at the depots is from forty to forty-eight cents a can in summer, and about fifty cents in winter. The milkman sells to the grocer at the rate of fifty to sixty-two cents a can, while the price paid by private families is either eight or nine cents a quart.

It has been estimated that the daily supply of milk for the city of Boston for the year ending March, 1872, was 24,009 gallons, which for the entire year would amount to 8,763,285 gallons, the cost of which to consumers may be reckoned at \$2,979,516.90. If we assume the average amount of water fraudulently added to be but twelve per cent., and this is putting it at a low figure, the amount expended by our citizens

* The cans used on different railroads are of two sizes,—one containing nine and one-half quarts, the other eight quarts and one-half pint.

during this year for water, apart from the legitimate water-rates, amounted to the sum of $357,541.92.

To indicate more accurately the full amount of the fraudulent gains in this trade, there should be added to this sum the value of the cream poured off from the top of the cans, and sold by the milkmen at a price varying from twenty-five to fifty cents a quart.

It would be foreign to our object to attempt to show where, or by whom, the process of sophistication was in any particular instance carried on, although on this point abundant and conclusive evidence is within reach. The Milk Act now in operation very wisely holds the milkman responsible in all cases for the quality of the article sold by him, and it lies within his power to protect himself from imposition on the part of the farmer or contractor, by requiring his cans to be delivered to him sealed with the stamp and name of the producer.

E.

Legislative Enactments with regard to the Sale of Adulterated Milk.

It may be desirable for the benefit of those who have not been led to investigate this subject to review briefly the nature of the enactments passed, at different times, by the state legislature, with reference to the sale of deteriorated milk, for it can thus be more easily pointed out in what respect these laws have been imperfect, or inefficient.

The first specific statute designed to punish fraud in this respect was passed in 1856. The punishment inflicted by this statute was a fine of twenty-five dollars for the first offence, and for any subsequent offence a fine of fifty dollars, or imprisonment from two to six months in the house of correction. It authorized all persons to make complaint, and prosecute to final judgment in our courts any violation of its provisions. The expensive burden of chemical analysis and of legal prosecution was thus thrown upon the victim of the fraud, a burden which, as may well be supposed, few individuals would volunteer to assume. As no prosecutions were ever attempted under this law, its effect was to afford complete immunity to roguery.

During the year 1858, the adulteration of milk began to attain to such magnitude, that public attention was very generally directed to it. Medical evidence was brought forward to show that the high rate of infant mortality in the large cities, during the warm weather, could be referred in no small degree to the unnutritious and indigestible character of the milk furnished at that season. The facts elicited at that time led to an improved and more stringent enactment, looking to the suppression of fraud by the obligatory appointment in cities of inspectors of milk, and the detection, conviction and punishment of adulterators. In August of that year (1859) the first inspector was appointed in Boston.

By the law of 1859 it was ordained that—

"No person shall offer for sale in this Commonwealth milk produced from cows fed upon the refuse of breweries and distilleries, or any other substance which may be deleterious to the quality of the milk, under a penalty of ten dollars for each offence."

This section, so far as it relates to brewers' grains, was obviously intended by its framers to apply to milk sold in certain localities, yielded by cows fed *exclusively* upon brewers' grains, it being well-known that an impoverished milk was induced by this unnatural diet. When, however, prosecutions were commenced under this law, chemists were introduced by the accused, who testified that cows could be fed *principally* upon these grains without any deleterious effect upon the quality of the milk yielded. It having been made to appear, therefore, that scientific men are not altogether in accord upon this question, the trial resulted in the acquittal of the defendants, and in consequence of this failure to obtain convictions, this portion of the law was subsequently repealed. It seems strange, that no attempt was made at that time to submit to competent analysis any samples of milk secreted by the animals who were really aimed at by the law, but that the *ex parte* evidence of so-called "experts," who themselves did not pretend to any experimental knowledge of the milk in question, should have the effect of nullifying that portion of the law, and causing its subsequent repeal.

The punishment inflicted by the law of 1859 was the insignificant fine of twenty dollars, nor was a second conviction attended by any increase of the fine.

By the law of 1863, the penalty was raised to fifty dollars for a second offence, and imprisonment in the house of correction for any subsequent offence. It also provided that the name of the offender should be published in two newspapers, printed in the county where the offence was committed. This last feature, *the publication of the name*, has in reality proved the one which is invariably the most dreaded by the delinquents.

In 1868, the penalty was fixed at one hundred dollars for the first offence, while a second conviction was made punishable by a fine of not less than one hundred, nor more than three hundred dollars, and imprisonment from thirty to ninety days. Another important change was made, however, at the same time, which served to render the whole statute almost useless. This change consisted in the ingenious insertion of the words "*knowing the same to be adulterated*," thus throwing the onus of proving guilty knowledge upon the government, inasmuch as it involves the production of testimony, which in the great majority of cases, is not accessible.

Soon after the passage of this Act, clear cases of gross adulteration were ferreted out, and laid before the grand jury, by the Boston inspector, Mr. Faxon. There was no doubt but that the samples seized were sold by the individuals accused, and a chemical analysis gave proof of the extent of the adulteration. Proof was wanting, however, that the accused were aware that the article sold was adulterated, and inasmuch as it appeared, in the absence of this proof, that no successful action could be maintained against these parties in court, no bill of indictment was rendered against them. The year that this law was in force, was marked by a large falling off in the number of complaints made in Boston. The number of bills of indictment returned by the grand jury, which, during the previous year amounted to twenty-one, was reduced under the law of 1868 to *two*, so that but very imperfect protection was afforded the public by this statute. The experience of this year illustrates pretty forcibly the effect of throwing upon the shoulders of the government the burden of proving guilty knowledge. The effect of this limitation was to render the law, in a large

majority of cases, unavailing, and thus to seriously interfere with the due administration of justice.

If the vender of impure milk is to be acquitted in our courts, because proof cannot be afforded of guilty knowledge, the inevitable tendency of this misplaced leniency will be to offer an inducement to carelessness and fraud. If, on the other hand, it is desired to protect the public from imposition, then the fact must be recognized, that in the sale of milk, as in the sale of drugs, it is not unreasonable to demand on the part of the vender the possession of a certain amount of knowledge, sufficient to enable him to estimate the character of the article tendered for consumption, and that in a matter which concerns so intimately the public welfare, any ignorance, neglect or carelessness should be held to be equally culpable with guilty knowledge.

The anomalous character of the law of 1868 having been made evident, upon the reassembling of the general court, the Act was changed, so that proof of guilty knowledge is no longer required. The law of 1869 took a more lenient view of the nature of the offence, in that it limits the amount of the penalty to not less than twenty, nor more than one hundred dollars for each conviction, making no mention of imprisonment, a punishment which has never yet been inflicted for this crime. By the statute of 1870, the sale of skimmed milk, in the place of pure milk, was forbidden. During the session of 1872, additional attempts were made to modify the Milk Act, so that as it now stands, its punitory clauses are as follows:—

AN ACT to prevent the Sale or Exchange of Adulterated Milk.

Be it enacted, etc., as follows:—

SECTION 1. Whoever sells or exchanges, or has in his possession with intent to sell or exchange, or offers for sale or exchange, adulterated milk, or milk to which water or any foreign substance has been added, shall for the first offence be punished by a fine of not less than twenty, nor more than one hundred dollars; and for any subsequent offence, by a fine not less than fifty, nor more than three hundred dollars.

SECT. 2. Whoever sells or exchanges, or has in his possession with intent to sell or exchange, or offers for sale or exchange, as pure milk, any milk from which the cream or any part thereof has been removed, shall be liable to the penalties provided in the preceding section.

SECT. 3. Whoever knowingly sells or exchanges, or has in his possession with intent to sell or exchange, or offers for sale or exchange, adulterated

milk, or milk to which water or any foreign substance has been added, shall for the first offence be punished by a fine of not less than fifty, nor more than three hundred dollars; and for any subsequent offence by a fine not less than one hundred dollars and imprisonment in the house of correction not less than thirty, nor more than ninety days.

* * * * * * * * * *

SECT. 6. This Act shall take effect upon its passage. [*Approved May* 4. 1872.]

Although not expressly stated in this Act, it is understood that the law of 1863 requiring the publication of the names of the offenders, when convicted, is still in force.

It must be obvious that, as the law now stands, owing to the difficulty necessarily experienced by the government in proving guilty knowledge on the part of the accused, the great majority of convictions will be made under section one. Furthermore, such are the proverbial delays in the administration of justice, and so frequent are the changes in our statutes, that the danger of conviction for any second offence is comparatively slight. The punishment, then, which under the present law is to be feared by offenders in case of detection, is the infliction of a petty, nominal fine, barely representing the amount of their peculations for a single week, and the publication of their names in the public journals. But, as has already been shown, milk is now so skilfully and systematically sophisticated that, as the milkman well knows, its inferior quality cannot be detected by the instrument ordinarily employed for testing it, and he finds, therefore, from experience that, unless his roguery is carried on to a reckless extent, he will incur but little danger of even falling under suspicion.

F.

CONCLUSIONS.

The provisions of the Milk Act now in force are the result of repeated efforts on the part of the legislature to frame an efficient law for the suppression of fraud, the previous enactments being in a measure experimental, and serving, so to speak, as stepping-stones to the present statutes. It is manifest that this law, as far as it goes, serves as a check, and only a check, upon the evils it is designed to suppress. These evils are threefold.

First. They affect the pockets of the producer by operating through the laws of supply and demand. The artificial increase of the supply has a tendency to restrict the demand, for genuine milk, and this necessarily causes a diminution in the price paid at the farmer's door, so that the profit afforded to him is now reduced to the *minimum.*

Second. The moral influence of a statute which aims only at restricting or limiting fraud, is obviously most injurious and demoralizing to honest dealers. What inducement is offered to the milk-seller to supply genuine milk at nine cents a quart, when, thanks to the ignorance of his customers, a sugared and diluted article is equally,—perhaps even more,—satisfactory to them at the same price? How is he to compete with his dishonest rivals in the trade, if no encouragement be held out to him to furnish the article in its natural condition?

Third. The deleterious effects upon the young and aged, as well as upon certain classes of invalids, all of whom rely for their sustenance upon the milk furnished by the milkmen, can scarcely be overestimated, and are so manifest as not to require recapitulation.

While frequent changes in the statutes are to be deprecated as offering additional loop-holes to offenders, experience has shown that no radical remedy can be expected from the present Milk Act, even when every effort is exerted by the most trustworthy officials to faithfully carry out its provisions. In the city of Boston the law has been vigorously and honestly administered, and it is satisfactory to know that through the efforts of Mr. Faxon, some of the more unscrupulous offenders have been exposed in the journals, this being, in fact, the part of the punishment which touches them most keenly. But it has not been deemed expedient, even in Boston, that any attempt should be made to bring to justice instances of fraud in which adulteration of at least fifteen per cent. cannot be proved by chemical analysis. In most other cities the inspector appears to be a sort of *succedaneum*, nominally holding the office, while his time is, in reality, occupied with other official duties, so that the law in these places remains nearly a dead letter. May it not be hoped that as public opinion becomes less apathetic and better informed, that our

statutes may be so reinforced as to become remedial rather than palliative; that thereby even the milder forms of malpractice may be successfully attacked?

To attain this result it is essential, in our opinion, that the punishment for this offence should be put in harmony with the sentiments of the community; that this punishment should be rationally severe, so as to attach to those convicted some stigma proportionate to the heinousness of the offence, and at the same time outweigh the amount of profit to be derived from the fraud.

As a starting-point, then, for improvement in this act, we are of the opinion that the penalty for the first conviction should be changed from a fine to *imprisonment*. Once let it be held *in terrorem* over this class of offenders that if detected they will be incarcerated, for even a brief period, in one of our public institutions, and the adulteration of milk will be viewed in a different light by jurors and the public, and will at the same time be rendered an unprofitable speculation for milkmen. To render the law more definite, and leave less to the discretion of juries, it is important to establish a uniform standard of comparison other than that of foreign authorities,—that is to say, to determine the limits beyond which the composition of pure milk is known not to vary, a point which could be easily settled by competent chemists. Milk which does not come within those limits would then fall under condemnation, whether its impoverishment were caused by skimming and watering, by the illness of the animal from which it was obtained, or by the unnatural character of the food furnished.

The adoption of such a uniform standard would also have the effect of preventing the introduction of the conflicting statements of incompetent *experts*, by which the minds of the jurors are so often hopelessly perplexed in this class of legal cases, wherein so much depends upon the unanimity of the scientific testimony. The law should further provide for the appointment of competent local analysts, to whom suspected samples may be submitted by the purchaser for examination at a moderate rate of charge, the fee paid to the analyst being reckoned, in case of conviction, as part of the costs to be recovered from the defendant.

But it must be borne in mind, that the prevention of crime depends quite as much upon the certainty, as upon the severity, of the punishment, so that, even after a stringent law has been framed, the independent action of individual communities and of local authorities is essential to give efficiency to its provisions.

ANALYSIS OF A CORRESPONDENCE

ON SOME OF THE

CAUSES OR ANTECEDENTS OF CONSUMPTION.

By HENRY I. BOWDITCH, M. D.,

Chairman of the State Board of Health.

ANALYSIS OF A CORRESPONDENCE ON SOME OF THE CAUSES OR ANTECEDENTS OF CONSUMPTION.

Boston, Nov. 10th, 1872.

To the Members of the Massachusetts State Board of Health.

Gentlemen:—In accordance with a vote passed by the Board, the following circular and list of questions were prepared. Some of these questions are evidently connected with what are usually deemed antecedents of consumption in Massachusetts, while others may seem to have little bearing upon them, and may be deemed futile or irrelevant.

Following a plan I have pursued in other kindred investigations, I prepared them so that they might be answered even monosyllabically, while they did not prevent, but rather invited, more detailed answers.

The result has been that I have received responses from over two hundred physicians. The tabular statements that will be given under each question are founded on returns from two hundred and ten. Other letters were received after the calculations were finished, and these are given either in the body of the correspondence or in an appendix. One hundred and forty-two came from Massachusetts, and sixty-eight from other parts,—Maine, Vermont, New Hampshire, Connecticut, Rhode Island, New York, Pennsylvania, Illinois, Michigan, London and Germany. These correspondents are physicians in active practice. Some of them are the most prominent men in the places where they reside,—prominent for their personal qualities, and as physicians. They represent at least tolerably well the medical profession of the various places from which they write. The "medical opinion," therefore, on the various questions, which comes from them, is worthy of the respect not only of this community, but of any one who feels an interest in the questions themsveles.

It may seem to many, as I have already stated, that the questions might have been very differently and better prepared; some that evidently might have been asked do not appear on the list. On the questions of intoxicating liquors, and their effects towards the production of consumption, it may seem that I have been too diffuse. The interest in the vast subject of intemperance in this community, and the obvious design of the legislature that, if possible, the various questions connected with the subject shall be discussed by our Board, is my only excuse for any prolixity that may be noticed in this particular.

If my life and health are spared, I hope, at a future time, to give more particularly my own views on the possible "Prevention of Consumption in Massachusetts." The labor involved in such a work will necessarily be long and irksome, inasmuch as I hope to have it based on private records of the cases of consumption I have seen since March, 1839; that is, during a period of thirty-three years. It is impossible for me to say how soon I can accomplish this object.

Meanwhile I remain, gentlemen,

Your friend and colleague,

HENRY I. BOWDITCH.

MEDICAL PUBLIC OPINION

ON

CERTAIN QUESTIONS PROPOUNDED BY THE STATE BOARD OF HEALTH,

ON SOME OF THE

CAUSES OR ANTECEDENTS OF CONSUMPTION.

The following circular and accompanying questions were sent out to our correspondents. The twenty questions will form so many subdivisions of this paper. After these will be found, in an appendix, certain more elaborately written letters, some of them coming from eminent physicians :—

COMMONWEALTH OF MASSACHUSETTS.

[Circular.]

STATE BOARD OF HEALTH, BOSTON, July 6, 1871.

DEAR SIR :—The State Board of Health has requested its chairman to report upon the means of preventing consumption.

The following schedule of questions has been drawn up by Dr. Bowditch for circulation among our regular correspondents, and other physicians, in the various parts of New England and elsewhere.

It is hoped that those who may receive it will be ready to assist in the collection of facts, by at least replying with a dot or dash under the words "Yes," or "No," opposite the different questions. But Dr. Bowditch will gratefully receive more detailed statements, and especially cases relating to family or personal history, involving the apparent causes or antecedents, or means of preventing this too frequently fatal disease.

As our report must be ready at the close of the present year, and time will be needed to analyze the returns, the undersigned would respectfully request that replies be made at as early a day as our correspondents may find convenient.

In behalf of the State Board of Health,

Very respectfully, your obedient servant,

GEORGE DERBY, M. D., *Secretary.*

(This half-sheet can be returned, in the accompanying envelope, to the Secretary of the Board, with such additional information as our correspondents may be willing to furnish.)

Opinions of Dr. ____________ of ____________, State of ____________

1. Is consumption caused or promoted by hereditary influences?
2. Can consumption be apparently prevented from occurring in children so hereditarily disposed?
3. What special means can be used for such prevention?
   (If so, please name these means on another sheet.)
4. Is consumption caused or promoted by the drunkenness of parents?
5. " " " " " " of an individual?
6. " " prevented " " "
7. " " " by total abstinence "
8. " " caused or promoted by the " "
9. " " " " overstudy at school or college?
10. " " " " overwork in trades?
11. " " " " special trades?
12. " " " " overwork of any kind?
13. " " " " severe bodily injuries?
14. " " " " " mental trouble?
15. " " " " marriage?
16. " " checked by marriage (child-bearing, &c.)?
17. " " caused or promoted by inordinate sexual indulgence?
18. " " " " contagion or infection?
19. " " " " exposed location of dwelling?
20. " " " " wet " "

Of course, the above are only a few of the causes that might be suggested. It is hoped that if any correspondent knows of any peculiar circumstances which he may deem important, in reference to the disease, information will be given in detail, as all facts upon the various questions will be gratefully received.

First Question.

Is Consumption caused or promoted by Hereditary Influences?

We have the following result from our correspondents:—

Yes,	205	
No,	1	
No reply,	4	
Total,		210

This table shows at a glance that only one of two hundred and ten physicians denied the great importance of hereditary influence in the production of consumption. Coming, as these returns do, not from theorists, but from physicians who see families grow up and die under their own care, this re-

sult, though perhaps not unexpected by some readers, certainly not by myself, is very significant. If we can ever have faith in medical testimony, every parent, and, still more, every one preparing, by marriage, to become a parent, should consider himself as forewarned by the above table. Still further, will not the State feel obliged, at some future time, to restrain the marriage of persons liable to breed consumption, even if it be considered improper and contrary to liberty, at present, to interfere with or prevent any such marriage, however inevitably it may be destined to produce a consumptive, wretched progeny? Massachusetts has yet much to do in "Stirpiculture," ere she can claim to be really a mother to her people.

Until that period arrives, each man and each woman is bound to consider this most important question before marriage.

I am well aware that this caution may seem to ignore all those keener instincts and emotions which usually govern the attractions of young people to each other before marriage. I know, moreover, the beauty of that self-sacrifice which would, at times, unite one healthy young person to another perhaps far advanced in disease. But sentiment must be ignored in any suggestions drawn from these tables of God's law, whereby we know that the defects, as well as the high qualities, of the parent descend upon the child "unto the third and fourth generation."

Extracts from our Correspondents' letters relative to this question.

Brown.—I do not remember to have seen a well-marked case of consumption where I could not trace the taint in the ancestry of the patient.

Burr.—I can call to mind several families where I have been able to trace consumption through three generations.

Gott.—Whole families are swept off by the hereditary taint. I saw, the other day, a youth of sixteen, just gone with the disease, who is the sixth of eight children that have died of the disease. I have noticed where the disease has been so destructive, that the complexion is blond,—light and light eyes.

King.—I do not remember any case of consumption which did not appear to have an hereditary foundation.

Parks.—The only case to contra-indicate a belief in the hereditary tendency of consumption, and favoring the theory of Niemeyer—which I recollect—was one of fatal pulmonary consumption, in which for a year, or upwards, preceding the pulmonary consumption (as fully declared by rational symptoms and physical signs), there were several attacks of acute bronchitis, which could not be accounted for by exposure to cold or otherwise. The patient was an only child, whose mother is now living, at an advanced age, and whose own two children (her only ones) are living, and not consumptive adults. The patient's father I know nothing of.

Hurlbert.—I find here, young men (born of consumptive mothers), who follow the sea, and have fine, well-developed chests, who are as often the victims as those who stay on shore, and are not nearly as well developed. All our sea-faring men are well formed, but it does not protect against the deadly germ of a consumptive ancestry. Oftentimes I find a whole family tainted with this dreadful plague, when the parents are cousins, and no hereditary influences are traceable.

Gammell.—I will cite the case of a family living in Berkshire County, the facts of which are all authentic. The father, to-day, is a hale old man, over ninety years of age; the mother died of phthisis about twenty years ago. Of the thirteen children, four have died of the same disease; of forty-eight grandchildren, eight have died of the same. These all have occupied places of ordinary healthfulness, and all have been engaged in agricultural pursuits.

My opinion is that hereditary influences are rapidly developed under the influence of soil-moisture, or any cause that lowers the vitality, and that any employment which deprives such a person of sunlight, pure air, or out-of-door exercise, conduces to the development of the disease.

Bonney.—About the year 1831, Rev. Dr. B—— came to this place from Boston, and was settled over the Congregational Church. The last years of his residence here he occupied a house, situated upon an apparently dry and healthy and slightly elevated piece of ground; but the sills were near the ground, and from the bank (once the margin of the Connecticut River) some three or four rods distant from the house, issue numerous springs.* I am told that the doctor's wife was confined to her house in Boston, at one time, for a year, with some form of skin disease.

The following is the mortuary record:

Eldest daughter—L——,	died Feb. 2, 1837.	Age,	22
Mother,	" Dec. 16, 1838.	"	43
Second daughter—L——,	" July 12, 1839.	"	22
Father,	" Mar. 22, 1839.	"	53
Third daughter—N——,	" Apr. 30, 1840.	"	23
Fourth daughter—E——,	" Oct. 4, 1840.	"	20
Eldest son—J——,	" May 4, 1839.	"	15
Youngest son—E——,	" Sep. 22, 1839.	"	2½
Youngest daughter—H——,	" Sep. 22, 1855.	"	20

One son has died since, at a distance—I don't know the particulars. One son is still living, aged about forty. The son J—— is reported to have died of diabetes; all the rest, of consumption. N—— died at Hanover, N. H. H—— lived all but two or three of her earlier days in S. H, and died

* See answers to twentieth question.

40

there. I am told that the Rev. Doctor stated that his father's family were consumptive.

Mrs. L—— D——— had two sisters die of consumption, and two of cancer. Three of her own children have died of consumption. One brother of her husband has lost three children by the same disease. Another brother has lost two children by the same.

C—— W——, an intemperate man, died of consumption. One or more sisters died of the same. He has lost at least four children in the same manner, one of whom had lived in Texas, one in Hadley, one in Northampton, and one in Chicago; the circumstances all being different as to occupation and mode of life. I am satisfied that the disease is decreasing. The town is much more dry, the food is of a better quality, and the people understand more fully the sanitary conditions essential to health.

I cannot but call attention to the excellent suggestions contained in the following remarks on the different influences affecting the Irish, in Ireland and in America.

Gavin.—Hereditary influence in causing phthisis is very far from being as common as medical writers would lead us to think. The majority of those who have come under my care were free from such cause. To those who are acquainted with the habits of the Irish, in their own country, as well as in America, there is much that deserves thought, and also throws light on one cause for phthisis, and points to the great importance of climatology. In Ireland, the peasantry live on diet principally made up of saccharine and fatty substances—potatoes and milk—while in this country, meat and bread form their principal diet. Again, in Ireland, the peasantry live in ill-built houses, but if they do, the doors are seldom closed, thereby insuring a good supply of pure air. Quite the contrary here—overcrowded tenement-houses, with small rooms opening into dark passage-ways, doubtful neighbors, and other things combined, oblige them to live with closed doors, so that ventilation is next to impossible. I am very much inclined to think that further investigation will show that the two agents above mentioned—radical change in diet and want of pure air—play a great share in producing phthisis amongst the Irish class of the community. In this respect I agree, to a certain extent, with Dr. W. McCormac, of Belfast, Ireland, who considers carbonized air the great factor in causing consumption.

The apparent good influence of alcoholic stimulants may be noticed in the following instance:—

Morse.—J—— B——, a man of wealth and healthy family; residence could be called an eminently healthy one. He married Miss S——. The S.'s all had consumption. He had three sons and five daughters. All the sons and three daughters died of consumption. The eldest son (J. B., Jr.) married S—— B——, whose mother died of consumption. S—— B—— died of consumption, and all her children, viz.: three daughters and one son. J. B., Jr., marries again, and before he died, begat a son, who, for many years was considered consumptive—had diseases of bones of face, fingers and hand, called *scrofulous*, which undoubtedly were *tubercular*, but by the use of concentrated nourishing food, pure air, and sunlight, he is now living, and apparently well. All medicines were dropped, and milk and brandy were substituted, when he began to gain, and his sores healed.

Hills.—Consumption seems to be caused, in some cases, by hereditary influences: by which I mean that consumption occurs in the children of parents that have died of consumption, or where the uncles or aunts have died of that disease. There are other cases where a parent has died of consumption, in which we find the children troubled with a scrofulous condition; such as enlarged glands, a puffy appearance of face, and sometimes of other parts of the body which does not seem to be firm flesh, or *adipose tissue.* My experience is too limited to be able to tell the result of such cases.

The following is analogous to statements already made above, in regard to the Irish in America:—

Huse.—As regards the development of phthisis, not from any hereditary taint, but apparently wholly from local causes I will cite the following:—A family of eight, the parents stout, athletic Irish people, with six children. At the date of my first acquaintance with them, March, 1866, they were all well, with but one exception. This was supposed to have been a cold, the result of suppressed menses from wet feet a month before. It was found to be a tubercular trouble, and proceeded to softening, and excavation in eleven weeks from the time of my first visit, when death ensued from phthisis. About the same time, a brother aged twenty-eight to thirty, consulted me, relative to cough: I found roughened respiration at the left top—no particular emaciation. I ordered cod-liver oil and whiskey, and advised him to leave town as soon as possible. One year later (1867) I examined the lungs of another daughter of the same family, and found tubercle and condensation of the top of the left lung so marked that there was no doubt in my mind as to the diagnosis and probable result. The brother went to Worcester; returned in 1869; came under my care and died in April, of dropsy, the result of chronic peritonitis with diarrhœa. The only child now at home is to all appearance healthy, but still has a marked resemblance to her deceased sister. Two remaining sons are in different parts of the country, location and health unknown. The parents are healthy Irish, living plainly, but substantially, on a farm.

Gould.—Happily consumption has almost deserted this town (Revere); there has not been a fatal case for years,—not since I wrote last upon this subject. Upon your first question I answer, Mrs. W——— died quite a number of years ago of consumption, between fifty and sixty years of age; her sister died at about the same age, and her brother died, aged sixty-three, of consumption. Mrs. W.'s daughter, M., married, died of pure tuberculosis of left lung, between her fortieth and fiftieth years. Mrs. W.'s son, R., had repeated attacks of hæmoptysis, and died after his thirtieth year. Another sister has been in a consumption for more than thirty years, and lives on. Her case is somewhat remarkable. For quite a number of years she has had repeated attacks of hæmorrhage, but instead of producing a debilitating effect, it relieves the oppression and soreness of the chest. She has been under my care for more than twenty years; uses no medicine, except an occasional dose of Morphia when the cough is too troublesome, also Tinct. Iodinii, and occasionally blisters, after taking cold. She is married, and over fifty years of age. My care has consisted chiefly in attention to the digestive organs. She has lost one son, aged thirty, by this terrible disease, and has other children fairly candidates for the same affection. The cases I report look

very much like hereditary consumption. The taint may continue to affect the offspring of this family, unless stronger and purer blood be mingled with it. But I have, until recently, firmly believed that, unless there was an hereditary predisposition to the disease, neither exposure, manner of living, nor the habits of the individual, pneumonia, bronchitis, nor any other inflammatory affection of the respiratory organs, would have the slightest effect in producing it. But, within a few years, I have been somewhat shaken in this belief. I have met with several cases, and have one under my care,—a young man of eighteen, who has a good chest and broad shoulders, and who has all the rational and physical signs of confirmed phthisis, and yet there is no family taint. None of his ancestry on either side, nor any collateral branches of the family, ever died of consumption; but the maternal branch of the family were asthmatic. It was apparently brought on by exposure to cold, producing severe capillary bronchitis and engorgement of the lungs.

Rice.—I know that many cases of pulmonary phthisis in this vicinity can be traced to hereditary descent. Often it is traceable to the second and third generation back.

Wakefield.—No doubt upon the point, that where the parents (one or both) are affected with tuberculosis, the offsprings are sure to inherit the disease.

Hunt.—Hereditary predisposition and the scrofulous diathesis cause it.

Call.—Nearly every case I have seen has had a decided hereditary influence, although every child born of consumptive parents does not die of consumption. Almost every patient dying of consumption has had some near relative die of the disease.

Butler.—Of its always being traceable to hereditary causes I have some doubt, for I have known of cases where no hereditary predisposition could be traced.

Howe.—I believe consumption to be hereditary, and, also, the inherited tendency to be the predisposing cause; but I do not believe this cause *of itself* sufficient to produce a fatal result in nearly all who may have this cause operating in the system from birth. * * * * The tendency may remain dormant during life, unless other conditions favorable to the disease should arise.

Second Question.

Can Consumption apparently be prevented from occurring in children, hereditarily predisposed to the malady?

The tabular statement is as follows:—

Yes,	120
Can be retarded,	15
No,	20
Doubtful,	10
No reply,	45
Total,	210

On this question of the ability of the medical profession to do anything to prevent consumption from appearing in children hereditarily liable to it, there is evidently much less certainty on the part of our correspondents than is shown by them on the first question. Fifty-five (26.23 per cent.) are either doubtful, or return no answer. Twenty (9.52 per cent.) return a peremptory "nay," as if they had seen few, if any, cases in which, after all had been done to prevent consumption, complete success had been the result.

Doubtless, all physicians have seen cases similarly suggestive of doubt of their ability to ward off the tremendous influence of blood. Fifteen (7.14 per cent.) think not that it can be absolutely prevented, but that it can be retarded. And finally, one hundred and twenty (57.14 per cent.) declare that they believe that the disease can be, by proper means, prevented in those children who are hereditarily predisposed. What these means may be, we shall, perhaps, get a glimpse of under another question. Meanwhile, let us take courage from the fact that more than half of our correspondents do have some hope of being able, at times, to influence the stern rule of one natural law by pitting against it other of nature's equally powerful influences.

Extracts from our Correspondents' letters relative to this question.

Packard.—Although not prevented in one or two generations, it may be in a series of begettings.

Stone.—Attention, care, and change of residence may do much.

Parton.—I do not think plain "yes" or "no" are admissible answers to this question. My opinion is, that a child, hereditarily predisposed to consumption, may be so managed as to have the development of the hereditary taint retarded, but to be prevented, I doubt. Contracted and ill-ventilated apartments are often a cause, and should be avoided.

Blodgett.—I am not aware of any such case, but I believe that much may be done by a correct system of prophylaxis to retard its development.

Gilbert.—Not generally, but occasionally with those who are intelligent, and have means at their command.

Third Question.

Are there any special means that can be used to prevent the development of Consumption in children hereditarily disposed?

The following is the tabular statement of "opinion" :—

By general hygienic measures,	24
By various specific directions, more or less elaborately described,	96
No means known to prevent it,	12
Doubtful,	5
No reply,	73
Total,	210

The large number of physicians who, while answering our other questions, feel compelled to refuse any reply to this one, and those who are doubtful, and finally those who answer in the negative, that they know of no special means of warding off consumption in those hereditarily predisposed to it, making in all 90 (42.85 per cent.), presents of itself a decidedly disheartening result in reference to the power of the medical profession to prevent this terrible disease from developing itself, even when forewarned. It proves, however, one thing, viz.: that, in the opinion of a large body of physicians, other and more thoroughly radical measures must be tried than those heretofore employed, before we can hope to cope with the fate impending over the child born of consumptive parents. And on looking at the answers of those who give an affirmative reply, we find only one hundred and twenty, out of the two hundred and ten (57.14 per cent.), who think that they can succeed in preventing the disease from coming on. Upon those special means beyond a "general hygienic treatment," which 24 (11.43 per cent.) believe in, we must refer to the more detailed answers under this question. This is a sad result, but notwithstanding all this want of faith in our power to ward off the disease in an ill-begotten child, I cannot but hope that in the far future, when men will think carefully when choosing their residences in which they

intend to rear their future families; and when a child is born, all the excellent hygienic laws that may be daily laid down for childhood and youth shall be fairly acted upon, every hour that the child is growing, and while youth is budding forth to manhood and womanhood; when professions and all trades shall be chosen with reference to the health of those who are to pursue them; when people learn that sun and air must freely bathe every part of a house; when men and women shall believe that it is impossible to violate a single law of nature without more or less suffering of body or mind as a consequence of that error or deliberate crime against nature's laws; when these halcyon days shall arrive, then we shall be better able to cope with this hereditary tendency, and, perhaps, shall then be able to crush it out. I think I have seen such cases where a discerning parent has warded off threatened disease, and has so reared a family that it has become even stronger than the average. He has done this, however, by commencing at their birth, and by constant, never-remitting care in reference to every influence which, during their tender years of growth, could have any deleterious effect upon their health. He believed that even one small error might sacrifice a life. His success, as I have stated, has been complete.

Extracts from our Correspondents' letters relative to this question.

Kingsbury. Change of climate, living and occupation, together with alterative medicines.

Curtis.—Sunlight, air and muscular development.

Bowen.—Out-door life and change of climate.

Goodrich.—Plenty of pure air, light and out-door exercise.

Stone.—Change to dry and even climate, from Cape Cod to St. Paul, Minnesota.

Blodgett.—By a correct system of hygiene, avoiding all that tends to lower vitality.

Brown.—I am not aware of any that have proved successful in finally securing the systems of those who are hereditarily disposed. Its development may be, and often is, postponed for a time by careful management.

Nye.—Regular habits of living; dwelling on high and dry land; temperate habits; warm clothing; good food, at proper times, and which should be eaten in a proper manner, thereby keeping the digestive and assimilative organs in a healthy condition; and, lastly, by breathing good air by night as well as by day.

Chase.—Change of air, climate, diet and general hygiene.

Dickson.—Bathing regularly, careful selection of food, regularity of hours for sleep.

Hathaway.—Proper diet, clothing, habits, climate, &c.

Deane.—Change of residence, habits of life and mode of living.

Reynolds.—Not *special* but *general* measures, attention to the rules of health, avoiding causes mentioned in Nos. 9, 10, 11, 12, 17, 18, 19, 20 of the circular.

Tracy.—I am not quite sure that I understand fully the intent of question 3. I know of no *specifics*, but, at the same time, my impression is that each case calls for special means, according to the peculiar constitution or condition or circumstances of the individual. In some, change of climate; in others, the use of iron; in another, cod-liver oil; in another, alcoholic stimulants; in another, change of circumstances, &c., &c. *In all*, the use of those means which will tend to *health*, in both mind and body.

Chapin.—Judicious food, extra clothing, and removal from all local causes.

Adams.—In the predisposed, especial attention to all the *little* precautions; especially in dress.

Smith.—Life out-doors; dry place of residence; good food, air and clothing.

Nichols.—Active exercise in the open air; and all the means that have a tendency to develop and strengthen the physical powers.

Spofford.—Anything that preserves the general health. Be careful about colds, fevers, measles, coughs, &c.

Soule.—Change of location, in my opinion, has done more to prevent consumption in children of consumptive parents, than all other means combined. In all the cases of consumption occurring in Winthrop* since I have lived here, the disease came with the patient from other places; and in some instances, the patient has been very much benefited by the change, and I am by no means prepared to say that an earlier change of location would not have resulted in a complete recovery.

Stone.—Removal to another and healthy location; living, as much as possible, in the open air; sufficient out-door exercise; liberal diet, and general hygienic measures.

* It will be remembered that Winthrop enjoys an almost insular climate, being a peninsular promontory projecting far out into Massachusetts Bay.—H. I. B.

I draw especial attention to the remarks on ill-ventilated apartments in the following letters :—

Parker.—The principles of hygiene are especially to be attended to—cleanliness, warm clothing, good, nourishing food, well-ventilated apartments, a plenty of out-door, fair exercise of body and mind, but neither overtasked. A very frequent and powerful cause in developing, if not in actually causing, consumption, is, in my opinion, a contracted, ill-ventilated sleeping-apartment.

Burr.—By placing children under the most favorable hygienic influences; regulating their course of study, hours of play, diet and sleep, their sleeping-apartments. We must see that their rooms are well-ventilated, and that proper attention be given to dress. We should insist upon such children wearing three grades of flannel under-garments during the year,—*very thick* during the winter months, *medium* in spring and fall, and a *thin* grade during the summer, after the middle of June.

Calkins.—Dry and pure air, in *well-ventilated* buildings; nutritious food and ample clothing; out-door life; attention to the slightest attacks of indigestion; and by the use of those medicines best suited to the promotion of digestion and assimilation.

Shaw.—All those agencies which tend to elevate the vitality, as pure air, especially at night; cleanliness; a non-conductor next the skin; sunlight; plenty of nutritious food, especially lean meats and milk; and a chance to get into *clean dirt* in the country.

Heath.—Generous diet, warm clothing, pure air, and continued exercise in the open air, have apparently made a strong and healthy boy of my own child, whose mother had hemorrhage from the lungs during gestation, and died of tubercular consumption two and a half years after confinement.

Dwight.—In my judgment the disease may be prevented frequently, although perhaps not always, by attention to diet, exercise in open air, sunlight, and judicious clothing.

Breed.—Removal from crowded tenements in cities, to open air on Western farms. Ten or twelve examples.

Brown.—Principally inunction and attention to diet. Different oils have been used in my practice, generally olive-oil, oil of sweet almonds, or goose-oil. Particular attention has also been directed to the ventilation of sleeping-apartments, and warm clothing for the lower extremities.

Field.—Exercise out of doors; the breathing of pure air, day and night; wholesome food; and having a good time generally. Re-breathed air, in the young and old, lays the foundation of consumption more than any other cause.

Ward.—In answer to No. 3, I have written "No." In explanation, I wish to say I know of no *special means* by which to avert such result. Still I have

great faith in *general means*, i. e., the strict avoidance of all depressing influence, and the use of all available means of improving the general health and strength. This rule, I believe, should be borne in mind in all the stages of the disease, as a *preventive*, and also as a *cure*. I believe the disease to be one of debility, and promoted by every means or agency which induces debility. I judge this to be the explanation of the very rapid development of the disease after continued fevers, especially in persons predisposed to tubercular disease. I believe that this one principle, if generally practised, would save many cases (of all ages and conditions) now lost. I am very sure that tonics are the only appropriate treatment (iron especially) for all cases of consumptive disease. I base this opinion upon a pretty extensive use of the preparations of iron, and the results, as compared with any other plan I have yet heard of. Expectorants, although sometimes necessary, should not be relied upon, as is the case with too many, both in and out of the profession.

Scammell.—I know of no method of preventing consumption, except by that *kind of diet* and *mode of life* which, in each individual case, is best adapted to *promote vigor* and *increase tone*. I have seen cases where consumption was evidently *delayed* in its progress by such means, and I have no doubt it may be sometimes *prevented* in those hereditarily disposed. I suppose Dr. Bowditch remembers the case in the Massachusetts General Hospital, exhibited and described to the class by Dr. Jacob Bigelow, when I attended lectures, nearly thirty years since. The man was sixty years old, and had been in consumption forty years. During that long period the disease had been kept at bay by the patient's pursuit of *mackerel-fishing*, which agreed with him. Of course, the particular mode of life should differ in different cases.

Haskell.—I think the proportion of fatal cases much less at the present day than they were forty years ago, when I began practice, owing, I think, in a great measure, to the mode of treatment. *Then* it was customary, hereabouts, to use a spare diet and depleting medicines; *now*, nutritious food and stimulants. It does not confine itself to any trade or occupation.

Reynolds.—I suppose you wish opinions founded on observation. I have not known consumption apparently prevented in children hereditarily disposed to it, because I have never known means used purposely in due season. I think it might be often prevented by life in the open air, or by a change of climate, *before the disease was developed*. Such means are rarely resorted to until after symptoms are manifested. A sea-faring life, a life in the army, an agricultural life, especially in a climate little subject to change, are doubtless among the best means of prevention. Compression of the chest, in females, not only injures them and their female offspring, but their male offspring as well. Females with any tendency to consumption should avoid all compression of the chest from earliest childhood.

Downes.—While some of the medical faculty of our country send their consumptive patients to the West Indies, while other physicians send their patients to Russia, it will be well to suspend judgment until sufficient data are furnished. It would seem, however, that *in medias res* would be the most judicious. I have no doubt but that moderate out-of-door exercise in a dry, exhilarating atmosphere, like Minnesota, is of more advantage than medicine.

Rice.—I know of no positive means of preventing consumption in children who have inherited a scrofulous taint from their progenitors. Every means to invigorate the general health should be used,—such as a generous diet, pure air, exercise in the open air, warm clothing in winter, dwelling in a high and dry altitude, and, perhaps, the administration of iodine and iron. Also, the patient should not be made to study or occupy the mind in a degree to produce lassitude. I think the constitution can thus be somewhat modified, and perhaps, in some cases, the scrofulous taint completely annihilated.

French.—Children should be kept, if possible, from the contagion of the exanthemata (measles, scarlet fever, &c.), should always be dressed in flannel, take the open air, and as much sunshine as possible; the feet should always be kept dry. If they have eruptions, great care should be used in applying ointments and washes; it is apt to transfer it to the head or lungs. They should practise temperance in all things.

Smith.—I would answer, first, a selection of a mild, dry and healthy climate; second, constant exercise in the open air (I mean a vigorous, free exercise); third, a highly nutritious food, avoiding pork; fourth, daily application of cold water to the skin, with friction; fifth, the cultivation of a cheerful and happy disposition; sixth, avoidance of all excesses. In this section, atmospheric vicissitudes are the most exciting causes. I have seen many caused by syphilis.

Fiske.—It has been my opinion that a person predisposed to consumption by hereditary taint, &c., might do much to ward off, or entirely to avoid it, by being well clothed, and taking that kind of exercise, out of doors, which would invigorate the system; and, at night, by sleeping in a dry locality, away from water or low, marshy ground.

Winsor.—Regular and interesting exercise in the open air, and free admittance of fresh air to the dwelling; a regular, easy (but not indolent) life, with cheerful and congenial social relations; plenty of sleep, and of nourishing and palatable food; animal warmth maintained more by clothing, and less by heating apparatus, than is customary.

Barker.—By avoiding the common causes, and pursuing a hygienic course; by taking active exercise; by occupation; by being much in the open air; and by attending to the first appearance of the disease with appropriate medication.

Collamore.—I think consumption is prevented in those predisposed to it in some cases, but it is difficult to say how, unless we say, in general terms, by the use of means which conduce to general healthfulness. Hon. and Rev. M. A., called by Mr. Webster "the model farmer of Plymouth County," who died a year since at the advanced age of ninety-four years, was troubled with hæmoptysis when a young man, and was thought to have had diseased lungs. I do not know that any special means were employed in his case, but I do know that during his long life he was a model of propriety in eating, drinking and exercise; that he avoided excitement and late hours. I have in mind now a young lady whose life is being prolonged by removal to Minnesota. She is very strongly predisposed, and the disease had commenced before her removal, two years ago, but is now stayed. There seems to be a period, from sixteen to twenty-five, or thereabouts, that seems to be a critical one.

If by any means the person is wafted over this period his immunity is very much enhanced. About a year since I lost a patient, the last one of seven children, all of which, with one exception, had died with consumption. She was the only one that I had attended. The others had died in different places, but all young. Two of the others, as well as she, had borne children. In her case I think I kept the disease in check for more than a year, by the use of Savory and Moore's Pancreatic Emulsion. The old homestead is in a dry location.

Miner.—I have in mind one case where the hereditary predisposition was very great, the subject being Dr. A. M. O., of H———, whose mother, two or three sisters, and a brother, died of it, and who had hemorrhage from his lungs, followed by pneumonia, about twenty years ago. He took cod-liver oil very freely, and some stimulants, after his recovery from the pneumonia for two or three years, and kept at the practice of his profession, over high hills and rough roads, and *always at it;* I might almost say day and night. He is now strong and well, and nearly fifty years of age. I have thought that his business, keeping him so much in the open air, and the oil and generous diet, with the care he has always taken to keep himself well protected by warm clothing at night and when the weather was severe, have been the means of warding it off. I have other cases of a similar character, and where the same medication and *exercise in the open air*, especially *horseback-riding*, have done much to prevent what otherwise seemed incurable. I have more faith in horseback-riding than in any other form of out-door exercise.

Wilcox.—Such means as are calculated to promote general health, and especially, a good appetite. I have a case under observation for the past year, in which there was positive evidence of tuberculosis developed in the upper portion of the right lung, in which there has been most marked improvement, though I will not yet say it is *perfectly cured* (a boy now sixteen years of age); by taking him out of school; by daily out-door exposure (except in the most inclement weather), and by making it a point that this exposure should, whether as an occupation or recreation have an object aside from the fact of its being for health. Added to this, he has taken, during the year, three bottles of Nichols' sirup of the hypophosphites of lime, soda, potash and iron.

Metcalf.—I think a permanent residence in a warmer climate, before the development, to any extent, of tubercle, has apparently prevented the occurrence of consumption in children hereditarily disposed. In a family in this town, of six children, all but one died of consumption, before arriving at middle life. He removed to New Orleans, and has constantly, except an occasional visit to New England, remained in the States of Louisiana and Mississippi. He has always enjoyed good health and never had any pulmonary troubles. I know "one swallow does not make it summer," but you will take my case for what it is worth.

Knight.—Clothing, diet, exercise; also, elevated location, with soft water.

Wilmarth.—The special means for prevention, I should divide under three heads; viz., *diet, clothing and hygienic influences.* We frequently find that children hereditarily disposed to consumption are undeveloped, physically; while the nervous system is unduly active, showing a precocity. This con-

dition, if encouraged or allowed to continue, undermines the constitution, and impoverishes the health, by using the material through nervous activity, that should go to the growth of the body. A *diet* for such condition should supply the waste and build up the body. The supply of waste will best be accomplished by the articles containing more or less phosphorus, such as wheat (not flour), beans, fish, &c.; while the growth of the body requires, in addition to these, the albuminous, carbonaceous and fibrinous compounds such as we find in meat, eggs, milk, corn and vegetables. In choosing a diet, reference should be had to the condition of the bowels, which we often find in a constipated state. This should not be allowed, without a persistent, constant and untiring effort to overcome it. Avoid pastry and food that can be swallowed whole. Choose the food that will need *chewing*, and *chew it thoroughly*. Take plenty of time to eat, and eat at regular intervals. Fruit and berries may be used with the meals to advantage, the acidity of them moistening the fecal matter; and the small seed and skin promoting the peristaltic action of the bowels. Avoid much drink with meals, as it tends to wash down the food before it is properly masticated. Let supper be the lightest meal of the day, so that the stomach will not be obliged to work during sleep. Encourage the habit of daily evacuation. Perseverance in these matters will usually overcome the constipated habit, if other hygienic measures are brought to bear at the same time. Cathartics should *not* be depended upon to relieve the condition; they are only temporary in their action.

The *clothing* should be neither burdensome nor scanty, but should be both light and warm. It should not be a ready conductor of heat, thereby causing the wearer to feel changes of temperature unpleasantly. Light woollen garments are more comfortable to the wearer, in this respect, than cotton, and I think, more conducive to health. Protect the extremities. Tight-fitting garments are neither comfortable nor healthful, and tight-lacing about the chest is positively injurious and ought to be discarded. Too much dressing about the neck is as injurious as too little. The practice of constantly wearing a hairy fur or woollen tippet, keeps the neck in a state of perspiration, and a person is thus always liable to take a cold,—to settle in the throat and produce irritation, with cough. *Hygienic influences.*—Under this head I would include *air*, *exercise*, *sleep*, restraint of injurious tendencies and the promotion of a healthy physical growth. The *air* should be pure, free from the influences of low lands or stagnant water, or impurities of decaying animal or vegetable substances; and it should be what is called a dry atmosphere. Such an air should be breathed freely, out of doors. Exercise, such as the system will bear without undue fatigue, should be taken *every day*. Special attention should be given to the healthy growth and enlargement of the chest and of the muscular system generally. A judicious use of calisthenic exercises would be very beneficial. *Sleep* should be encouraged in the *early part of the night*. If children are kept up late, it is at the expense of the nervous system, and the morning sleep does not fully compensate for the loss. *Occupation* of such children, until they are seven or eight years old, should be very light, mentally, with just enough physical employment to keep them out of mischief. It is better that they should not go to school before this age, and when they do go, the mental effort should be restricted to the physical capacity. I do not mean by this, to encourage habits of laziness, but to avoid what is too often the case, *pushing* a forward child. In choosing an occupation for after-life, one should be taken that avoids sedentary habits or close confinement. Trades where fine dust is a

necessary attendant, should be avoided. *Injurious tendencies* are those which in any way weaken the constitution; such as overwork, overstudy, too much play, excess of any kind, frequent or continued excitement. Anything which calls for an outlay of nervous force more than is conducive to health, should be restrained. Work, study, play and the excitement necessarily attending them, are healthful and needed to properly develop the system, and should be encouraged with alternations of rest, so that a healthy reaction, not an exhaustive fatigue, may follow.

Gilbert.—A healthy location; proper food, clothing and exercise; and regular habits.

Parsons.—Diet, climate and voluntary expansion of chest.

Rice.—I know of no means of preventing it, in children of consumptive progenitors; or, at least, no means other than those used to invigorate the general health.

Wakefield.—Children who are clad in flannel; fed upon beef, mutton, etc., instead of pork; well guarded against sudden changes in temperature, may apparently, escape tuberculosis. An exciting cause, e. g. pneumonia, may develop the latent disease.

Hammond.—The special means of preventing the disease in children, are those which tend to produce a healthy and vigorous action of all the organs of the body. This can be done by proper exercise, taken when the body is not exposed to any improper state of the atmosphere, either of cold or dampness. Exercise in the open air, when the temperature is too low, or when there is much dampness, is not proper. The condition of the system when the person takes the exercise, should be taken into account. If the system is exhausted, in a measure, the exercise should be performed with caution. The clothing should be suited to the season; the diet nutritious. In fact, whatever tends to render the system active and vigorous, also tends to protect the body from all predisposition to disease.

Haskell, of S., Me., says (communication received too late to be used in the general analysis),—

a. By good nourishing food, largely animal.

b. By abstaining from alcohol and tobacco, especially the latter.

c. By abstaining from inordinate indulgence of animal appetites.

d. By the use of flannels, (if in New England) the year round, to chest, legs, and arms.

e. By residence in a dry climate, of high latitude.

f. By leaving home, and the cares of home, once or twice in a year, especially if they go from "the shore," inland.

This last clause (*f*) applies, in my experience, grandly, in the treatment of consumption. By this course, and by the use of clams, oysters, fish, etc., and cod-liver oil, and porter, whiskey and hot flax-seed tea, etc., with an inhalant mixture, life has been made more comfortable and prolonged.

Abell.—To prevent the development of the disease in children, there should be extra care in guarding against exposure to wet, and chills, by attention to clothing; by using plentiful nutrition; and by keeping the

digestive system in good order; rather than by any specific drugs; and by encouraging exercise in the open air, in such systematic ways as would develop muscle, and expand all the air-cells of the lungs, thereby leaving as little soil as possible, for the development of the causes of tubercle; but that any means would entirely prevent the development of those causes, occurring at, or before birth, I am not so positive. I have examined the lungs of infants, dying with other diseases, at the ages of four or six months, whose lungs were studded throughout with minute tubercles. I think change of climate might effect a good deal, in preventing tubercular development, as I have known severe cases to recover, after two years' residence in Minnesota—both first and second stages—though I think the benefits claimed by residing in Minnesota, overrated—but I know many families who were apparently predisposed to consumption while living in New England, whose children almost *never* had phthisis developed in Minnesota. There is certainly quite a difference in the atmosphere, in some way, as I found I could myself bear twice the exposure, in Minnesota as in New England, without taking cold. My wife, also, who has been severely attacked with "hay-fever,"* for the last fifteen years, (beginning in the latter part of August, and lasting from six weeks to three months,) whenever she visits Minnesota, escapes the attack invariably, and breathes as freely as anybody. On returning to Massachusetts the attack comes on again. She tried this experiment three times, with the same result.

Luce.—In a family of seven, four boys and three girls, all the girls and two of the boys died of consumption, under the age of twenty-five. The two remaining boys were the youngest of the family; the eldest of these began to manifest symptoms of the disease, and embarked for California, where he recovered, and is now strong and healthy. The youngest is still at home, but in feeble health. The father of this family, is a farmer and fisherman, and is now seventy-two, hale and sound; the mother sprung from a consumptive family, and died in middle life.

Butler.—By attention to diet and general habits of life; by change of location and climate, if one or both should seem to promote the disease; out-door exercise, such as shall tend to expand the chest, and give full, free play to the lungs.

Hartwell.—The especial means to be used for the prevention of consumption in children hereditarily disposed, besides a strict observation of all hygienic laws, are, *if the mother is affected*, the employment of a healthy nurse who shall have the whole care of the child, or, if one cannot be obtained, a healthy woman, who shall feed the child with cow's milk, properly diluted. When milk, drawn from one cow, well-known to the family, is not to be had, Comstock's Food, (Liebig's formula) has been used by me, in two cases, and both thrived remarkably well. *If the father is affected*, the mother may nurse the child, but ought not to have the father under her charge or care, at the same time. Second, and as important, I think, is the separation of parent

* "Catarrhus Autumnalis" would be, I think, the more correct term, according to the recent admirable researches of Dr. Morrill Wyman, on that very distressing malady.

Autumnal Catarrh (Hay-Fever), with three maps, by Morrill Wyman, M. D., late Hersey Professor of the Theory and Practice of Medicine in Harvard University. New York: Hurd and Houghton. Riverside Press. Cambridge, 1872.

and child. (I cannot say that I think we are warranted in making the separation forcible.) If proper ventilation could be enforced, occupying the same house would not be objectionable; but that is almost impossible. This applies to children also, and some of the difficulties are removed. Of course, the various tonic remedies are not to be omitted, of which the best is cod-liver oil, if any tendency to emaciation exists.

Holmes.—Warm flannel clothing; fresh meat, butter, milk and eggs, diet; out-of-door exercise in high and dry location; with pure air, erect position, with free and full expansion of the chest, are among the best means of prevention.

Hills.—A case of mine had Pott's Disease, and while under treatment pulmonary tuberculosis was developed. I do not think an abscess of the vertebra opened into the pulmonary tissue, although the child previously had an abscess which pointed a little anterior to the large trochanter. The child wasted quite rapidly, had severe cough, and profuse expectoration of thick grayish and yellowish sputa. The child took iodide of lime, and, some of the time, a sirup of the hypophosphites, but most of the time cod-liver oil and some expectorant. In the spring and early summer he began to improve, and by fall was quite fat and hearty; cough continued, but less severe. Improvement lasted, without relapse, until April, 1871, when the child was taken with diphtheritic croup, and died after two days' illness. In this case I think the tuberculous symptoms were evidently abated, and I was led to hope for complete recovery, had the patient not died of another disease. And here I will state that this child took exercise in the open air whenever the weather permitted it; also ate largely of sugar, and I think, drank milk freely. At the time of death it was four years seven and a half months old.

A case came to my knowledge where the mother died of consumption soon after the birth of a daughter. I do not know that that child had any appearance of disease, but the father determined she should have a chance to be robust, so he had the child well and warmly clad, thoroughly protected from the vicissitudes of the weather, and then sent her forth, at all times, and in all kinds of weather. At the present time (unless recently indisposed), the young lady (of seventeen, I presume) is, to all appearance, in perfect health. I cannot answer whether consumption will assail her in later years, but it is my opinion that without the physical training she went through, she would now be suffering from incipient phthisis.

Harlow.—I desire to instance a family consisting of father, mother and four children, two males and two females, in which the parents both died of phthisis fifteen years since. The children were supposed to inherit the tendency to tuberculosis, were separated, placed in good families, locality changed, regular systematic hygienic rules were enforced in each case. All have arrived at mature age and are now in robust health, though one of the girls gave signs of incipient pulmonary trouble nearly three years since, which soon disappeared upon making a radical change in her mode of life, viz., removing her from school and keeping her much out of doors.

Call.—Change of climate and change of associations are among the best preventives of the disease in question.

Aiken.—The best hygienic conditions, such as in infancy, "plenty of milk, plenty of sleep, plenty of flannel!" Later, a country life, especially in the

summer; plain, but nourishing food, brown bread or its equivalent at least once a day; regular habits generally.

Haynes.—Diet; exercise; location; judicious use of such articles of food and drink as will promote the development of bone and muscle.

Spalding.—No specifics, but such general treatment as will promote sound physical health.

Carbee.—First, attention to diet; second, avoid exposure, either riding or driving, in open air; third, administration of suitable tonics whenever indicated.

Bullard.—Removal from consumptive family; out-door employment and nourishing diet; also removal to another State, as going West.

Carr.—Temperance, air, exercise in open air, avoiding all manner of debilitating practices of body or mind, favorable location, etc.

McCollom.—Out-door exercise, sleeping-apartments well ventilated, plain, nutritious diet, cleanliness, proper clothing, eight or ten hours' sleep.

Fairman.—Large, well-ventilated sleeping-apartments, plenty of exercise in open air, journeying, especially on horseback, good, wholesome diet, freedom from care, attention to the general health, avoidance of cold, wet, damp, and exposed localities.

Ranney.—I am sorry to say, after a practice of twenty-five years, and observing cases treated and not treated, that answers to your questions must mainly be conjectural, and, consequently, of little value. The conclusion to which I have come is this: tuberculosis results from a peculiarly depraved condition of the system, generally hereditary. If otherwise, and the predisposition not transmitted, there is not sufficient evidence to establish proof of *cause.* Until the cause is ascertained, the way of prevention or promotion seems to me very *dark* and *blind.* Conclusion,—a glorious uncertainty about the whole matter contained in the questions.

Richmond.—Free, timely, and proper exercise in a pure atmosphere. Special attention should be paid to the digestive organs, or blood-making machinery, that the greatest possible amount of good, wholesome food may be converted into blood; and all condiments (stimulating) be avoided. *Tobacco, the greatest bane to human kind,* from its enervating power, is to be avoided in every form *by all means.* *Porter,* more than any article in my practice, prepares the digestive organs for nourishment, and guards the system against tuberculosis.

Mayo.—Change of climate.

Bolan.—I think cod-liver oil, with a constant and small dose of liquor, will retard the disease, and at times, produce a cure. I have seen a few children recover when one lung was entirely diseased.

Lincoln.—Let the child, in infancy, receive its nourishment from a healthy nurse, free from any hereditary taint; a strict attention to cleanliness, keep in a moderate temperature, a sufficient quantity of clothing, pure air and sunlight. Let it sleep with a healthy, but not old, person. In childhood give it healthful, but not too violent exercise, so as not to prostrate those weak powers, but rather to invigorate and strengthen. If the patient is in a state of perspiration do not check it too suddenly. The brain should not be overtasked while the physical powers are weak. There should be an entire abstinence from any of those indulgencies which are so antagonistic to nature. It is our conviction that, by a strict adherence to these prophylactics, there is a possible escape from the terrible scourge which cuts down so many of the human race.

Sanborn.—Moderate exercise daily, regular habits, such as regularity in eating, drinking, sleeping, and attending to calls of nature, dressing properly, not wearing clothes so close as to punish and disfigure the person, amusements, generous diet, change of location or climate, and keeping in the open air as much as possible when the weather is suitable. A change of climate I consider almost absolutely necessary, and, in the majority of cases, indispensable. Also amusements,—everything which tends to cheerfulness of a moral character.

Robbins.—1st. Residence in the country. 2d. Attention to diet: food to be taken at least four times a day, till ten years old, which is to be largely animal—especially milk; sugar not to be rejected, but largely and judiciously used, as taking the place of fat in adult life. 3d. Bathing, almost daily, with frequent change of clothing. 4th. Constant out-door life. Such children by *no means to be sent to public schools.* Body before mind. Make romps of them rather than precocious prigs.

Bromwell.—Extraordinary attention to general health.

Eldredge.—I believe consumption to be decidedly hereditary, and that where there is this tendency life may be prolonged by generous living, residing in a favorable locality, having regard to drainage and exposure rather than to temperature; always sleeping in an upper chamber; and by avoiding harassing care and hard labor of every kind.

Collins.—Good air, food, residence, surroundings, and everything that goes to make a perfect animal.

Peaslee.—Hygienic means, especially out-of-door occupation.

Condie.—I have seen cases in which children, male and female, strongly predisposed by hereditary taint to tubercular phthisis, have had the disease arrested, or, more properly speaking, have been saved from a development of the disease, by a proper hygienic course of treatment, including diet and regimen, especially when pursued in conjunction with a complete change of climate—from one marked by dampness and rapid transition of temperature to an elevated, dry, inland situation with an equable temperature. Even in adult life, I have known pulmonary tuberculosis, after it was actually com-

menced, arrested in its course by the above means. In one instance—that of a man named K——, some thirty-eight years of age—a saddler by tradé, laboring under tuberculization of the lungs, at my advice, changed his occupation to that of drayman. This calling he pursued unintermittently for about six years, and affected an *entire cure*, as, after a very close examination, I verily believe to be the case.

Murchison.—Good nourishment, and removal to a *dry* climate of equable temperature. Since I had the pleasure of meeting Dr. Bowditch in London, more than fifteen years ago, when he demonstrated his views to a meeting of the London Medical Society of Observation, held at my house, I have been satisfied of their soundness, and for many years I have taught them annually in my lectures.

Plimpton.—Dry locality and fat meat.

Bennet.—Hygiene, and country life.

Snow.—Warm clothing, especially of the chest, arms, legs, and feet, in infancy, childhood and early youth, particularly in females; good food; a large amount of out-door exercise; little brain-labor before fourteen years of age; a general observance of the laws of health, and no "dosing."

Blanchard.—By keeping the digestive and assimilative organs in a healthy condition, and avoiding those causes which produce a certain inflammatory condition of the lung tissue, which *almost* invariably results in the deposition of tubercle.

Smith.—(*a*) Proper food, which should consist largely of milk; as the proportion of milk is diminished, animal fats must be taken in other forms; also vegetable oils, in the form of nuts. Beef, mutton, fowl and fish, so varied as always to be relished. Fruit and vegetables, in variety and abundance. *Unbolted cereals* in proper quantities. (*b*) Proper clothing, with particular attention to the temperature of the extremities, both sleeping and waking. (*c*) Sufficient opportunity for sunlight and fresh air, with exercise. (*d*) Plenty of sleep, in large, dry, and well-ventilated apartments. (*e*) Avoidance of excitement, fatigue, and exposure to any depressing influences. (*f*) When the child is well fed and cared for in other matters of hygiene, there is little to be done in the way of medication; but I have thought that the Tr. Ferri Chloridi, largely diluted with the sirup of sugar, and taken after the meals, for a period of one or two weeks at a time, with like intervals, one of the best medicinal agents to use.

Fisher.—Frequent change of residence; selection of healthy locations on dry, porous soil; in unshaded houses; sleeping apartments ample, *well ventilated*, in second or third story, admitting sunlight freely; with the greater part of daylight spent in the open air; in moderate and judicious exercise; and with the observance of the well-established hygienic laws, as regards clothing, diet, mental emotions, &c. An observation of twenty years gives

me the fullest conviction that quite a number whom I have now in mind, and who at this time are enjoying tolerable, if not robust, health, would have long ago filled consumptives' graves, but for precautionary measures, including those enumerated above, which, by advice, they have observed in a greater or less degree. Some of these had only strong predisposition; others had actual tubercular deposition, with all the usual symptoms of incipient phthisis, lasting from three to fifteen months, and having added, in the latter number, the physical condition of confirmed consumption. I must admit, however, that some cases which seemed as favorable for recovery as these now living, and observing the same hygienic influences, have succumbed within two or three years from the first attack. Nevertheless, I have not the slightest doubt that a great number may be saved.

Howe.—First of all, the hygiene of the system claims our attention. This is mainly comprised in four things—clothing, rest, exercise and diet. The person should wear flannels next the skin, throughout; he should observe perfect regularity with regard to the remaining three; should retire and rise early; should take plenty of exercise in the open air, always remembering to be suitably clad.

An out-door employment should always be preferred for one having a tuberculous diathesis. The diet should be thoroughly substantial, nutritious, and easily digestible. Excess in eating, as in exercise, should be avoided.

The above, I consider first in importance; but secondly, what can we do by way of medication?

Cod-liver oil has proved more efficacious in my hands than all else. I can refer to cases which presented marked symptoms of tuberculosis, which came up, under its *persevering* use. By *persevering*, I mean six, twelve, eighteen months, or more. Many fail in obtaining the desired effect because they do not continue the remedy long enough.

Fourth Question.

This question, and the subsequent ones, up to and including number eight, were suggested in order to meet the absorbing interest which we all have in the terrible evil of intemperance. Doubtless, in the estimation of many readers, some of these questions may seem useless, or perhaps absurd; and the results may seem equally futile, in the estimation of others. But, as I consulted brevity, in order to get any answers, I hope that all captious indifference, or opposition, will rest while we try to arrive at some results, however small, towards the elucidation of this subject of such importance to the future health, morality and intellect of the people of Massachusetts.

Is Consumption caused, or promoted, by the Drunkenness of Parents?

The documents allow of the following table :—

	Yes.	Yes; by depriving children of comforts, &c.	No.	Doubtful.	No reply.	Totals.
In Massachusetts, .	63	3	33	18	26	143
Outside of Massachusetts, . . .	37	6	11	1	12	67
	100	9	44	19	38	210

I confess to a feeling of surprise when considering this table. I had supposed that medical opinion would be more unanimous in its condemnation of intemperance in parents, because of its effect upon the offspring, and its tendency to cause consumption. But it would seem that drunkenness, amid the many horrors that it entails upon the offspring, does not, in the minds of a great many of the profession, tend to cause consumption. Out of our two hundred and ten correspondents, only one hundred and nine (51.43 per cent.) answer in the affirmative, viz., that they believe drunken parents bring consumption upon the children. One hundred and one (48.09 per cent.), on the contrary, take either the negative, or are doubtful, or decline to answer.

There is another rather curious result of the above table which, as prepared, shows the number of correspondents in and out of the State. It is this, viz.: that in Massachusetts there is less belief in the power of intoxication to cause the begetting and rearing of consumptive children than there is out of the State. This is shown by the different proportions of affirmative answers, in the two, viz.: 64.18 per cent. of those outside of the State, to 46.15 per cent. from Massachusetts. Moreover, there seems less doubt about the question, among physicians outside, than among those resident within the State. We cannot, of course, draw positive conclusions from such small numbers. Nevertheless, this seems to me a singular result, when I remember that here in Massachusetts,

discussion on the evil results of intemperance have been going on for so many years; and, in which State, therefore, one must believe that the results of intemperance must have been brought to the notice of the profession and the public as much, at least, as elsewhere.

Extracts from Correspondents' letters upon this question.

Reynolds.—Yes, by producing feeble offspring.

Hammond.—Drunkenness of parents deprives children of the comforts of life—often, of proper covering for their bodies, of proper food, or lodging, and thus their vital energies are exhausted, and any disease is liable to develop itself.

Jordan.—I have never seen a parent who drank to excess who did not have consumptive children.

Hunt.—A drunken parentage is a cause.

Fiske.—No, no further than surrounding circumstances bear upon the case.

Dwight.—Sometimes, by neglect and bad food.

Gavin.—Yes, especially when the *mother* is a drunkard.

Holmes.—No, except by the neglect it causes.

Richmond.—Some cases may be found where poverty may cause too close confinement and a lack of suitable nourishment, where it may be a cause.

Harris.—By defective organization and impaired vitality.

Fisher.—I cannot say I have known cases where drunkenness has *directly* caused consumption by the effects of liquor on the system. Cases of phthisis occurring in the progeny of drunkards are so constantly preceded by poverty, neglect, exposure and violations of the laws of health that it would be difficult to determine what agency drunkenness had in causation, otherwise than in producing the circumstances under which they occurred. In a few cases the children of drunkards, or of those addicted to the excessive use of ardent spirits, without positive intoxication, and in comfortable circumstances, I have been able to satisfy myself that the disease was due to other causes.

Fifth Question.

Is Consumption caused or promoted by the Drunkenness of an Individual?

On this question there seems a great diversity of opinion. The table is as follows:—

	Yes.	Yes; as secondary to gastric, etc., troubles.	No.	Doubtful.	Unanswered.	Totals.
From Massachusetts,	71	5	30	13	24	143
Out of "	38	3	17	-	9	67
	109	8	47	13	33	210

Thirty-three (15.71 per cent.) decline to answer the question; thirteen (6.19 per cent.) are doubtful; forty-seven (22.38 per cent.) say "no," while one hundred and nine (51.90 per cent.) of the two hundred and ten correspondents answer decidedly in the affirmative, and eight say that the disease occurs in consequence of the disturbance caused in the stomach and digestion by the beastly habit of intemperance.

The question, undoubtedly, is a difficult one; meanwhile, it cannot be said that medical opinion, as tested by this correspondence, sustains the idea that consumption necessarily is caused or promoted by intemperance in the use of alcohol. Meanwhile, some very singular coincidences, to say the least, arise, in which consumptive tendencies seem to disappear with a really intemperate use of liquor, a reference to some of which will be found under next question.

Extracts from Correspondents' letters upon this question.

Burr.—In cases of consumption in the intemperate, probably drunkenness was the secondary cause.

Parker.—In all cases of tubercular consumption of the lungs in drunkards, which I can now recollect, that disease seemed to be developed secondarily to disease of the liver, or stomach, or both.

Winsor.—When superintendent at Rainsford Quarantine Hospital I had quite a number of cases of phthisis in the wards, where the habits were drunken, and where it could not be doubted that the disease advanced faster on this account. But there was scarcely one not acted on when out of hospital, by all manner of other depressing and warping conditions, so that it would have been impossible to separate and analyze the parts played by each in developing and advancing the disease.

Barker.—Bronchial consumption sometimes takes place when the general strength and digestive system are broken down by drinking.

Hills.—I have a patient now, in whom I believe phthisis has been promoted by the excessive use of intoxicating drinks. This case seems to be ameliorated by the use of cod-liver oil, two parts, and Tinct. Cinchona Co., one part, (the dose being one tablespoonful,) but whether the disease will be arrested remains to be seen. An expectorant also is being used in this case, but no stimulant other than the cinchona.*

Wakefield.—I had a patient several years since, a soldier in the Mexican war, very dissolute. I treated him for fractured patella and mania a potu at the same time. He was an habitual drunkard. He finally had a severe attack of hæmoptysis, and died of rapid consumption. This, I think, might have been prevented by sobriety and good food.

Hunt.—In my judgment the most potent causes are the drinking customs of the community, and the prevalent use of intoxicating liquors as beverages.

Clary.—I cannot give an opinion respecting the influence of alcohol, except that I believe that all depressing influences, whether physical or moral, tend to its development, drunkenness amongst the rest.

Watson.—I do not recollect an instance of consumption in an habitual drunkard.

Palmer.—Yes; by inducing inflammation.

Sixth Question.

Is Consumption prevented by the drunkenness of an individual? In other words, Is a drunkard less liable than others to Consumption?

On this question we have sufficiently curious results. The tabular statement is as follows:—

	Yes.	In some cases checked or retarded.	No.	Doubtful.	Unanswered.	Totals.
Reports from Massachusetts,	21	3	72	16	31	143
Reports from other places,	6	4	41	1	15	67
	27	7	113	17	46	210

Forty-six (21.90 per cent.) decline to answer; seventeen (8.09 per cent.) doubt; one hundred and thirteen (53.80 per

* But this cinchona tincture is medicated alcohol.

cent.) answer in the negative; whereas twenty-seven (12.86 per cent.) answer "Yes," and seven (3.00 per cent.) say that consumption is retarded.

In the present state of public opinion in regard to the use of intoxicating drink it requires some moral courage to say anything in favor of alcohol. To declare that it sometimes seems to save the drunkard from the consumption to which he is hereditarily predisposed, requires not only moral courage, but a sincere conviction of the truth of the assertion made. The fact, also, that only a little more than one-half (53.80 per cent.) declare that the disease is not prevented by drunkenness is a small proportion, provided the profession generally hold that the opposite opinion is the correct one.

Meanwhile there have been some very peculiar examples in certain families, which seem to indicate that intemperance, bad as it is at any time, does nevertheless in certain cases apparently have some good effect in warding off consumption, for in these instances the only persons that have escaped out of entire families were the one or two who indulged inordinately in the use of spirituous liquors.

Perhaps one of the most curious documents supporting the idea that intoxication with ardent spirits tends at times to prevent consumption may be found in the letter from Theodore Parker to the chairman of the Board, written in 1858, in which he gives details of his own family history. Mr. Parker had no doubts about the matter, and in that letter expresses the belief that "intemperate habits (where a man drinks a pure, though coarse and fiery liquor, like New England rum) tend to check the consumptive tendency, though the drunkard who escapes may transmit the fatal seed to his children." * I will add that I have no doubt that, by the wretched constitution the drunkard usually entails upon his offspring, that seed is much more likely to spring into life than in the robust begetting of the temperate and healthy.

It is evident that the question is still a debatable one, to be decided by a more careful study of more facts.

* Appendix, page 515, vol. 2, "Life and Correspondence of Theodore Parker," by John Weiss; New York, 1864.

Extracts from Correspondents' letters on this subject.

Smith.—Think I have seen life prolonged by it; no definite facts.

Spofford.—They, i. e. drunkards, sometimes live to old age.

Reynolds.—Father and some children died of phthisis. Three sons became "free livers," and still live, strong and stout.

Parker.—Yes; by moderate use of alcoholic stimulants; not to the extent of drunkenness.

The following is a very significant, if sad, case:—

Blodgett.—I have in mind an individual who seems to have warded off tuberculosis by a long-continued debauch. There seems to have been a cessation of tubercular activity from that time onward. When the individual, by virtue of his inherent manhood, ceases for a time to use alcoholics, tubercular activity sets in. The connection between the two seems in this instance to be certain.

Gilbert.—The progress of some cases may be checked by the moderate use of stimulants.

French.—From an experience of twenty-six years, I do not believe that alcohol causes or prevents consumption. This disease has been diminishing in this part of the State, especially in Warwick and Royalston, Mass., Richmond and Winchester, N. H., towns in which I have practised more or less for the past twenty years, and in that time there has been a great reformation in temperance. In Warwick, in a mortality of thirteen, for the last seven and a half months, there was but one case of consumption. It is hilly and dry; no swamps, no stagnant water, no nuisances of any kind; people remarkably temperate.

Howe.—I do not think drunkenness in itself really injurious to the consumptive; the other vices, which are usually associated with it, are. If we could have the former without the latter, alcohol might frequently be beneficial.

Butler.—Does this involve the free use of whiskey and other stimulants in the treatment of consumption? If so, I answer no; for, in my opinion, no case of consumption, hereditary in its nature, was ever cured or essentially benefited by the free use of stimulants. An unnatural excitement may be produced, which may be mistaken for returning health, but it is only awakening hope to be ultimately disappointed.

Abell.—I should be sorry to be understood as recommending drunkenness as a cure. But I have known several instances where nearly all the family, from five to nine children have successively died of phthisis. Finally, one of the boys, from sheer desperation, took to excessive drinking of alcoholic stimulants. These boys are now past middle life, and enjoying good health when last heard from. In two families, not less than five or six victims in each were carried off by consumption. In each there was always one sick, and a short time before death another would be prostrated. In one family

they resorted to that horrible relic of superstition, the burning of the heart, etc., of the *dead*, and the ashes were swallowed by the survivors, in the hope that the fatal demon would be exorcised from the family, but it did not avail. But another son fell a victim; and then the alcoholic treatment was tried, not as an expected remedy, but as a means of forgetfulness of impending doom, and no deaths in the family have to my knowledge since occurred.

Rice.—I believe the moderate use of liquors, by persons of a consumptive habit, to be a means of preventing the disease. I have known intemperate people die of consumption, but cannot say that the disease was hastened to a fatal termination by the habit.

Richmond.—There are some cases in the country where poverty might beneficially modify the diet, and compel the child to take a more active course of life, and make him more healthy than would be the case in affluence. In other words, poverty, growing out of drunkenness, might reduce the family to a plainer mode of living; compel its members to adopt a more active life; and thus improve their physical well-being, though they may be predisposed to consumption.

Carr.—Not unless one dies of drunkenness, before consumption develops itself.

McKenzie.—Very rarely is phthisis found amongst drunkards.

Smith.—Consumption is not *prevented* by drunkenness, but may be influenced beneficially, in severe cases, by a free use of spirituous and malt liquors.

Twitchell.—I know that I differ from many, but I am satisfied from my experience that I am right. I never knew a person cured or his life prolonged when in a consumption by the use of alcoholic spirits; but in several instances have known it—consumption—caused by alcohol itself, or by the effects of poverty and exposure, which are often attendant upon persons who largely indulge in alcoholic drinks.

Seventh Question.

Is Consumption prevented by total abstinence on the part of an individual? In other words, will total abstinence save a man from Consumption?

The table stands thus:—

	Yes.	Retarded.	No.	Doubtful.	Unanswered.	Totals.
Returns from Massachusetts, ...	25	1	58	19	40	143
Returns from outside of Massachusetts, . .	13	4	31	3	16	67
	38	5	89	22	56	210

Thus we see that nearly one-half (42.38 per cent.) take the negative, viz.: that total abstinence does not prevent consumption; and ten per cent. are doubtful; 26.67 per cent. makes no reply; and only thirty-eight (18.09 per cent.) say that consumption is prevented by total abstinence.

This question, it must be admitted, is very difficult if not, strictly speaking, impossible of solution.

Nevertheless I asked it, thinking that some facts might be elicited, like the following, viz.: that in the family of some drunkard, where many have been given to intemperance, and have died of consumption, one who had practised total abstinence escaped the disease. No such case, I believe, is on record. I regret the conclusion, but think it possible that no such case has occurred. The following comparison of percentages of answers to the sixth and seventh questions, as more clearly illustrating the opinions of the profession on this subject, is interesting:—

	Yes.	Retarded.	No.	Doubt.	No answer.
Consumption apparently prevented or retarded by intoxication, ...	12.85	3.33	53.80	8.09	21.90
Consumption apparently prevented or retarded by total abstinence, ...	18.09	2.38	42.38	10.45	26.66

Extracts from Correspondents' letters on this question.

Winsor—I would answer in the affirmative if under it were to be included those persons who cannot drink without going to excess, and for whom there is no middle course between drunkenness and total abstinence.

Barber.—If a person becomes a total abstainer in early life, consumption may be prevented, and long life secured.

Wilcox.—I have no reason to believe that the moderate use of spirituous liquors would have the effect to cause, or prevent, consumption.

Harris.—Yes; as concomitant of good hygienic care.

Brownell.—A temperate use of stimulants is beneficial in this disease.

Butler.—The less a consumptive uses of stimulants the better he will be; and judicious diet, exercise, &c., the less liable he will be to the disease.

Richmond.—In the moderate use of stimulants there is less liability to the disease. (I have been a total-abstinence man for forty-three years.)

Rice.—I have never seen so much consumption among that class of people who use liquors moderately, as among the strictly abstemious.

Eighth Question.

Is Consumption ever caused or promoted by the total abstinence of an individual from Intoxicating Liquors?

Tabular form of returns is as follows:—

	Yes.	No.	Doubtful.	No answer.	Totals.
From Massachusetts, ...	17	71	17	38	143
Outside of Massachusetts, . . .	9	35	3	20	67
	26	106	20	58	210

The preponderance, one hundred and six (50.47 per cent.) of negative over the affirmative, twenty-six (12.38 per cent.) answers, is not unexpected. The cases in which total abstinence would have any marked influence in causing or promoting consumption, if such be ever the fact, must necessarily be very rare. They would indicate either an inability to bear alcohol, or a martyr-like spirit of abstinence for principle's sake; either of which, to the extent indicated, must be very rare in our community. For even the most rigid of temperance advocates do not refuse stimulants when directed by the physician. The small number of affirmative answers, twenty-six (12.38 per cent.), suggests either a careless mode of answering (which I am not willing to admit, inasmuch as each person could, if he had chosen, have declined to answer that question, as in fact, fifty-eight (27.62 per cent. actually did); or it suggests that there are a certain number of cases

in which physicians believe that total abstinence really promoted what the *temperate* use of alcohol might have retarded or prevented.

I am quite sure that there are individuals now in this community, who are ill from various other complaints, in consequence of their strict adherence to rules of total abstinence, and who are immediately benefited by a physician's prescription of the temperate use of some alcoholic medicine. One can believe, therefore, that rigid abstinence might so lower vitality in some persons, that consumption might more easily occur than in others who use alcohol carefully.

Extracts from letters of Correspondents' on this question.

Barber.—In confirmed habits of intemperance, a little stimulant will sometimes prolong life.

Tracy.—The temporary use of alcoholic stimulants is sometimes essential to the prevention of consumption.

Rice.—I believe strict abstinence to be a means of hastening the fatal termination. This has been according to my observation.

Wakefield.—Total abstinence would not cause consumption.

Ninth Question.

Is Consumption ever caused by overstudy at School or College?

	Yes.	Yes; indirectly.	No.	Doubtful.	Unanswered.	Totals.
From Massachusetts, .	92	4	15	8	24	143
From other places, . .	54	3	6	2	2	67
	146	7	21	10	26	210

The few that have declined to answer twenty-six (12.38 per cent.) indicate the interest the profession has in the question, and not only its willingness, but also its belief, in its ability to answer it. Let us look at the returns, therefore,

carefully, and see if they indicate anything worthy of notice by our legislators and boards of education. A large proportion (including "Yes," and "Yes, indirectly,"), viz., one hundred and fifty-three (72.85 per cent.), answer affirmatively. In other words, nearly three-quarters of the profession, as represented by our correspondents, declare that by our system of education, we really tend to produce consumption. If this be not worthy of serious thought by our people, I know of no question that can be.

Those who answer in the negative, twenty-one (10 per cent.), and those that are doubtful, ten (4.76 per cent.), are comparatively few. Doubtless what one of our most intelligent correspondents (see letter from D. N. S. Davis, of Chicago) suggests, may be, in certain cases, true; viz., that it is not the great amount of intellectual labor, but the small amount of physical work—the total neglect of it, in fact—together with numerous other bad hygienic conditions, which brings consumption to our scholars. I cannot hold wholly to this opinion. I believe with the majority on this question, and sincerely trust that the opinion of the profession thus expressed, will have its due weight. I have seen not a few patients—scholars—who, under the violent stimulus put upon them by an approaching exhibition or examination for rank or for prizes, have sunk immediately after such extra intellectual labor, wholly prostrated in body and mind, and when I have seen them, far-advanced consumption was plain. Such cases are utterly hopeless.

Extracts from Correspondents' letters on this question.

Fiske.—Overstudy and want of exercise ought to promote consumption.

Ring.—I cannot say about its causing consumption; health is often impaired.

Field.—I have not much faith in hard study's causing disease of any kind amongst students. If their health declines, the cause can usually be traced to other sources than study,—as dissipation, bad food, bad air, want of proper exercise, use of tobacco, etc.

Stone.—Overstudy at school or college, or any depressing cause, may develop the disease, if sufficiently continued, in a subject predisposed.

Wakefield.—Overstudy at school or college would not cause consumption unless scrofula existed.

Hammond.—Overstudy is a fruitful source of consumption by debilitating the system.

Hunt.—Confinement and overstudy in academies and schools.

Harris.—Yes ; as sequel to impaired nutrition, &c.

Knight.—Yes ; if insufficient muscular exercise.

Call.—I think I have never seen a case of consumption caused by overstudy at school. They may have received the fatal blow while at school, but from their habits of life rather than from hard study.

Hopkins.—A *mediate,* not independent cause.

Fisher.—Only in connection with some violation of physical laws, late hours, close apartments, vitiated air, excessive mental emotion otherwise than study, and irregularities of various kinds.

Tenth Question.

Is Consumption ever caused or promoted by overwork in trades?

The table stands as follows :—

	Yes.	Yes; indirectly.	No.	Doubtful.	No answer.	Totals.
From Massachusetts, . .	108	4	4	5	22	143
From elsewhere, . .	54	5	4	2	2	67
	162	9	8	7	24	210

As the last question, this, also, becomes very interesting and important when we take a glance at the great number answering in the affirmative, either categorically or with an explanation, one hundred and seventy-one (80.14 per cent.), and compare this proportion with those answering in the negative, eight (3.8 per cent.), or doubtfully, seven (3.33 per cent.), while there are but few that leave the question unanswered, twenty-four (11.42 per cent.). It would seem hardly possible there should be no foundation in the opinion that certain

trades seem to cause consumption. There were only four (1.9 per cent.) out of the whole number who answered simply in the negative. But for the further elucidation of this matter of overwork in trades we may refer to special letters.

Extracts from Correspondents' letters on this question.

King.—I can't say about its causing consumption; health is often injured.

Miner.—Steam work in manufacturing establishments not properly ventilated, or very low.

Haskell.—Perhaps consumption occurs more in those of sedentary pursuits.

Field.—Neither do I consider that overwork, *as such*, causes much disease, but combined with unhealthy food, impure air of shops and dwellings, and among mothers of families with confinement within doors, together with the cares and anxieties attending household affairs and the rearing of children, overwork is productive of many cases of consumption.

Wakefield.—Overwork in trades might cause consumption, especially in an improperly ventilated room.

Hammond.—Overwork, by debilitating the system, tends to cause the disease.

Jordan.—No doubt the excessive efforts of young men and women to get an honest living, confined in small, unventilated workshops, has a great tendency to cause consumption.

Ballou.—Yes, from dust.

Plimpton.—Close confinement and dust will develop an hereditary taint.

Eleventh Question.

Is Consumption ever caused by certain trades?

The table runs thus :—

	Yes.	No.	Doubtful.	No answer.	Totals.
From Massachusetts, ...	102	7	7	27	143
From elsewhere, ...	56	2	2	7	67
	158	9	9	34	210

In answering this question, also, the affirmative seems to predominate very much. For example, we have one hundred and fifty-eight correspondents (75.24 per cent.) out of the two hundred and ten who believe that certain trades cause consumption, while nine (4.28 per cent.) say "nay"; and those who are doubtful are the same in number, while the number of those who do not reply is thirty-four (16.19 per cent.). The answer, of course, only gives the fact that, of the profession, 75.24 per cent. of our correspondents believe that certain trades cause or promote consumption. For the special trades which, in the opinions of the same correspondents, produce the effect, we refer to letters.

Extracts from Correspondents' letters on this question.

Workman.—In Iron-workers.

Greene.—Shoemaking and factory-life.

Brown.—Shoemakers who work in overheated and ill-ventilated shops are especially liable to consumption. The dust-laden air of cabinet-makers' shops seems to excite the disease in those predisposed. Workmen here consider dust of black walnut particularly irritating.

Dickson.—Wood-turning, dry-grinding in scythe-shops, etc.

Belden.—Such as cause the workmen to inhale irritating substances.

Hathaway.—Workers in tin, etc.

Smith.—Close confinement in mills, ill-located and ill-ventilated boarding-houses, poor food, and cotton-dust.

Spofford.—Several have left trades that others do well in. A shoemaker died suddenly at seventy-six, another is living at eighty-five—close workers—on the bench forty and fifty-five years.

Calkins.—Especially stone-cutters and grinders of metals.

Smith.—Where they are confined to dusty rooms.

Burr.—Operatives in cotton-mills especially liable to it.

Stone—Manufacturing shoes, sail-making, etc.

Hills.—Working in palm-leaf.

Dwight.—Polishing-rooms.

Breed.—All those trades which compel to a constrained position, preventing free expansion of the chest, and also those where, from the character of the material wrought, the air is filled with particles of organic or mineral materials.

Rice.—I have known consumption either engendered, or early developed, in grinders and polishers of iron and steel. A polisher, in this section, hardly ever lives more than four years, and almost invariably he dies of consumption. Cannot there be some invention for delivering the polishers from the *emery wheel*, so that only a section of the wheel shall be in the room where he stands, leaving all the works and flying particles of steel in another room; or some protector to wear on the face?

Shaw.—I have no doubt that some parts of pianoforte making and cabinet-making prove *exciting causes*, by the large amount of fine dust necessarily inhaled while veneering and sand-papering the dry surfaces before polishing.

Wilcox.—Have seen it developed in millstone cutters and grinders of iron and steel, but consider it only secondary to inflammation and ulceration of the bronchi.

Goodenough.—Shoemakers.

Priest.—Cabinet dust is injurious; sewing-machines.

Holbrook.—I occasionally see here what is called, in popular language, "grinders' consumption." The main employment of the inhabitants of this village is that of making axes, hatchets, etc. A part of this work is done over the grindstones and polishing-wheels. The air of the rooms constantly contains the insoluble particles of stone and emery. These particles, in the process of respiration, settle in the lower bronchial tubes, and gradually fill the smaller ones completely, until the lungs assume almost the appearance of the liver, and are almost impervious to air. This condition causes a loss of strength and an inability for much exertion, from shortness of breath, which usually ends in the death of the victim in eight to ten years in the case of *grinders*, and in twelve to sixteen years in the case of *polishers*. Death often comes sooner from pneumonia and bronchitis, to which this sort of lung is peculiarly susceptible. Medicines are of but little use in grinders' consumption. Many of the persons having this diease return to Canada—whence all the grinders and polishers come—as soon as they begin to find themselves unable to perform their accustomed amount of labor; therefore the fatal cases seen here are much less in number than if the operatives were native-born.

Garin.—Hard work, constant and long hours, with insufficient food, account for many cases of phthisis amongst poor girls who earn their living by sewing. In most of these cases the distance between their residences and workshops is too far to permit of going home for a hot dinner, so that we find them compelled to make, what ought to be the principal meal of the day, on pies and cold meats. I know of no greater evil than this, and some attempt should be made either to give two hours for dinner, or to establish

boarding-houses on the coöperative principle, where good dinners should be furnished at a moderate profit.

Gilbert.—Brass-workmen and shoe-cutters.

Holmes.—Tailoring and shoemaking.

Harlow.—I would mention "machinists," and what are known in tanneries as "beam-house workers," or "fleshers."

Wakefield.—I had a patient who worked in a brass foundry. He complained of the fine particles irritating the membrane of the bronchial tubes. He died of fully-developed tuberculous disease.

Ballou.—From irritation.

Bolan.—Yes, cotton-factory.

Call.—Yes; railroad conductor.

Palmer.—Confining; dusty.

Peaslee.—Sedentary, as shoemaking.

Brownell.—Those are worst where operatives inhale deleterious particles.

McKenzie.—Very common amongst tailors at the West End of London.

Twitchell.—Machinists, particularly those who are engaged in turning iron-castings, or use the emery wheel, I think are more liable to the disease than those who work in wood; unless, as in the rail-shops, they use sand-paper.

McKean.—Watchmakers and jewellers.

Twelfth Question.

Is Consumption ever caused, or promoted, by overwork of any kind?

Here is the tabular statement:—

	Yes.	Yes; perhaps.	No.	Doubtful.	No answers.	Totals.
From Massachusetts, . .	94	3	10	5	31	143
elsewhere, . . .	49	6	3	2	7	67
	143	9	13	7	38	210

The fact shown in the above table indicates that the profession inclines to the affirmative more distinctly than one would have anticipated. One hundred and fifty-two (72.38 per cent.) believe the proposition; thirteen (or 6.19 per cent.) say "nay;" seven (or 3.33 per cent.) being doubtful; while thirty-eight (or 18.09 per cent.) do not answer the question.

It would seem, therefore, that the same thought has occurred to the vast majority of the profession, that has often occurred to myself, during my professional life, viz.: that the people of this country are overworking generally. We have no pastimes; no "long vacations;" we give no rest to ourselves, or our employés. The struggles for life are so great, and the "accursed love of gold," the nature of our political institutions, our stimulating climate, all urge us to work, and to overwork. Even in our parties, during the winter, and at gay watering-places during the summer, there is no rest, but "the dance of death" goes gayly round all the time,—whether we work or play. This is a sad statement, but, I believe, true.

Extracts from our Correspondents' letters relative to this question.

Hitchcock.—Yes; army-life.

Greene.—Dr. Bowditch will, perhaps, recall the case of M—— T——, whom he saw with me, and who died last year of acute tuberculosis. She was the oldest of seven children, then living. Here was no family history of consumption; parents both grandmothers, and several aunts, still living. Her place of residence was elevated and salubrious, not damp. We could assign no exciting cause, unless perhaps carelessness, and application as an amanuensis. Now her third brother, a rather undersized and effeminate-shaped youth, a dry-goods salesman, gives unequivocal signs of developing phthisis, but of a type less acute than his sister's.

Bullard.—No; if out of doors.

Murchison.—Yes, mental overwork included.

Thirteenth Question.

Is Consumption ever caused, or promoted, by severe bodily injuries?

The table is as follows :—

	Yes.	Yes; perhaps.	No.	Doubtful.	Unanswered.	Totals.
From Massachusetts, . .	61	5	28	9	40	143
elsewhere, . .	41	1	10	1	14	67
	102	6	38	10	54	210

If we can trust the above table as giving the views of the profession generally, as it does those of our correspondents, we must infer that severe bodily injuries do not very generally cause, or promote consumption.

The analysis of the above table shows that 102+6=108 (51.42 per cent.), of the affirmative (and some of these are doubtful) are about balanced by those holding the negative, thirty-eight (18.09 per cent.), the doubtful, ten (4.76 per cent.), and those who do not answer, fifty-four (25.71 per cent.). Here, again, I agree with the small majority. I cannot now remember any case in which I could trace consumption to a physical injury.

Extracts from letters from Correspondents on this question.

Smith.—I think I have seen it follow severe drainage from wounds.

———.—By causing confinement indoors.

Miner.—Saw one case in which it was apparently caused by the debility consequent on a severe wound.

Wakefield.—An injury to the lungs, otherwise sound, might develop the disease.

Haynes.—Yes, if confined to the thorax.

Brownell.—All kinds of chest wounds, and any exhausting disease, or injury.

FOURTEENTH QUESTION.

IS CONSUMPTION EVER CAUSED, OR PROMOTED, BY MENTAL TROUBLE?

The table resulting from our correspondence, is as follows:—

	Yes.	No.	Doubtful.	No answer.	Totals.
From Massachusetts, ...	97	14	8	24	143
elsewhere, ...	53	4	2	8	67
	150	18	10	32	210

The importance of this question cannot be over-rated; and the above table presents very interesting results. If we compare the number holding the affirmative, with those holding the negative, of the question, the difference is very great, one hundred and fifty (71.42 per cent.) against eighteen (8.05 per cent.). Then, too, the number who are doubtful, is small, ten, (4.76 per cent.), and of these who do not answer, also small, compared with what is noticeable about other questions, viz., thirty-two (15.23 per cent.).

Altogether, the returns indicate that the question is an interesting one to our correspondents, and a large proportion of them believe themselves justified in the proposition that mental anguish promotes, or causes consumption. Though at one time expressing perhaps a rather different opinion,* I now must hold to the dogma that we cannot separate the various elements of man. Man is body and mind; they are mysteriously joined, they mutually re-act, one on the other;—psychology, physiology and pathology are irrevocably joined. A healthy mind cannot be in an unsound body; and, vice versa, an unhealthy mind, which mental trouble, even of the briefest duration, must cause, will tend to interfere with some of the fundamental laws of physical health; and by doing so

* Consumption in America. "Atlantic Monthly," February, 1869.

may tend to produce consumption, by a lowering of the vital powers.

Extracts from our Correspondents' letters relative to this question.

Luce.—One case where no hereditary predispositions—young lady—love affair.

Hills.—I can give no special case, but have thought that patients who were given to despondency, waste more rapidly than those who seemed hopeful.

Wakefield.—I think not. Such cases die off by exhaustion of nerve-force, softening of the brain, and effusion within the cavity of the brain.

Hammond.—I think mental trouble tends to cause it.

Fifteenth Question.

Is Consumption ever caused, or promoted, by marriage?

The table is as follows :—

	Yes.	Yes; perhaps.	No.	Doubtful.	No answers.	Totals.
From Massachusetts, . .	47	1	46	9	40	143
elsewhere, . . .	33	2	17	3	12	67
	80	3	63	12	52	210

Our correspondents do not have any decided opinion on the question; eighty (39.52 per cent.) being in the affirmative, and sixty-three (30 per cent.) in the negative, while fifty-two (25.66 per cent.) decline answering. Undoubtedly, a properly governed marriage, entered into by young, reasonable, healthy people, tends to longer happiness and more healthful life than any ascetic celibacy can bring about. But the exceptions to this state of perfectly robust health, on the part of contracting parties, are numerous, and I have little doubt that in some instances, consumption

may be promoted, if not caused, by marriage, if imprudently contracted, and subsequently unwisely or incautiously consummated.

Extracts from letters from Correspondents on this question.

Ward.—I don't think matrimony necessarily has any effect, either as cause or cure, or even in preventing or accelerating the development of tubercular disease. If improperly or excessively employed,—as in child-bearing or sexual indulgence,—it undoubtedly often does.

Hunt.—Early marriage is a cause.

Haskell.—By overbearing of children; and confinement.

Reynolds.—Yes; in the female.

Stone.—Yes; if unhappy.

Smith.—I believe excessive venery induces the disease.

Nichols.—I have known many cases in both sexes where individuals having no hereditary predispositions to this disease, and marrying those who were so predisposed, have had the disease developed, and which has gone on to a fatal termination.

Field.—Marriage, in itself, promotes health. And yet many a woman entering the marriage state with a physical system enfeebled by unhealthy modes of living, training and education, and perhaps constitutionally disposed to disease, finds an early grave from phthisis, promoted by the bearing, rearing and care of children, together with other injurious influences.

Mann.—Yes; when the partner is tuberculous.

Haskell.—By early marriages and frequent pregnancies.

Belden.—Rather increased after birth of child.

Abbot.—When physically and morally coaptated.

Spalding.—Yes; promoted in persons predisposed.

Knight.—No; unless over-indulgence in the sexual relation.

Hopkins.—Promoted not by marriage but by the burden of domestic cares.

Sanborn.—Marriage is not necessarily a cause of consumption, but inordinate sexual indulgence which almost invariably follows, is, in my opinion, one of the chief causes of consumption.

Carbee.—Not, except where the parents are predisposed.

Bullard.—Two instances where but slight signs of any taint, but the inordinate sexual intercourse produced the disease in the female.

Brownell.—Not in itself, but from sleeping with and inhaling the breath of a consumptive person.

Eldredge.—If marriage did not bring an increase of cares it would have a favorable influence in both sexes, but as it generally does, it oftener has the contrary effect.

Mackenzie.—With men, but not with women.

Snow.—I have no doubt, from personal observation, that early marriage and the early development of the sexual function tend to promote consumption.

Smith.—Marriage commonly promotes health, and hence may check consumption, but when it brings undue burden or indulgence, especially too frequent child-bearing, it promotes its progress.

Howe.—I said *promoted* simply because I find marriage is almost always attended with inordinate sexual indulgence, especially in the young. Were it not for this fact I do not think it would be considered a promoter of consumption.

Hurlbert.—I think consumption, in this locality, is promoted more by intermarriage than by any other cause except hereditary taint.

Sixteenth Question.

Is Consumption ever checked by Child-bearing, &c.?

The table is as follows:—

	Yes.	Checked during gestation; more rapid after.	It is possible.	No.	Doubtful.	No answers.	Totals.
From Massachusetts, . .	71	22	4	21	6	19	143
From elsewhere, .	32	15	2	12	1	5	67
	103	37	6	33	7	24	210

This table is interesting in several respects, viz., first, suggesting the interest the profession has in the question, only 24 (11.42 per cent.) having declined to answer it. Second, in the fact brought out by 37 (17.61 per cent.) that consump-

tion, while being checked by pregnancy, seems to run on more rapidly after delivery. Third, including the three first columns under the one head of affirmative, we learn that one hundred and forty-six out of the two hundred and ten (69.52 per cent.) of all the correspondents believe that consumption is checked by child-bearing.

Extracts from Correspondents' letters relative to this question.

Deane.—Its effects are modified very much by circumstances; sometimes checked, sometimes promoted.

Shurtleff.—Seems to retard it till confinement, and then to hasten it to a fatal termination.

Blood.—Checked while with child, but rapidly advancing after the birth.

Lindley.—I think I have seen it checked, but too often child-bearing promotes it.

Spofford.—Several died soon after delivery.

Burr.—Have notes of two cases of marked phthisis checked by child-bearing.

Winsor.—I am confident that I have seen the progress of the disease checked while pregnancy lasted, some half a dozen times. On the other hand, I have seen it hastened by lactation.

Blodgett.—Have now under operation a lady who, having borne three children in as many consecutive years, seems to have laid the foundation of a continually progressing tubercular action by this constant requisition upon her surplus vital energies. The family have a tubercular taint attending each generation, this lady only, of the present generation, having been the subject of tubercular activity. The connection between manifest tubercular action and the exhaustion consequent upon too frequent parturition, here seems to be plain and direct.

Stone.—I have just lost a patient from consumption, who was delivered of a seven-months' child on the day of her death. She came under my care about the time she became pregnant, and her disease steadily advanced,—her condition rather made worse by her pregnancy,—till her death. The autopsy showed most extensive disease of both lungs, tubercular in character. Consumption is not a frequent disease in this town, and the population is too changing to permit me to express any opinion decidedly.

Reed.—I have known several cases where the progress of the disease seemed to be checked by repeated pregnancies with short intervals. Prolonged lactation develops the disease rapidly.

Morse.—I have known of five cases where women having consumption, the disease was checked on becoming pregnant; but they died soon after parturition, the disease progressing with renewed vigor. I think I have seen several cases of consumption caused or promoted by lactation.

Luce.—I have known cases checked by child-bearing.

Rice.—Child-bearing often hastens the development of tubercular phthisis.

Haskell.—Those I have seen were cases of *apparently incipient* phthisis, and from the extreme suffering of the *first three months*, attended by a cough, &c., they certainly did better for a time. In other cases, doubtful effect.

Knight.—Checked during pregnancy, but developed rapidly afterward.

Carbee.—The disease is seemingly transmitted from the child to the mother.

Bullard.—No; but promoted.

Condie.—It is a curious circumstance to how great an extent in a female with confirmed consumption upon her becoming pregnant the symptoms of the disease will assume a favorable aspect, foreshadowing, as it were, a speedy convalescence, but rapidly after parturition the disease will assume an unfavorable aspect, running on quickly to a fatal termination. (I would refer you to two papers of mine in the "American Journal of Medical Sciences," April, 1871, page 365; July, 1871, page 119.) I have prepared a paper which may appear in the October (1871) number of the "American Journal," it is on "spurious or simulated consumption."

Eaton.—Many of the causes, &c., in the list of questions might be connected. Thus marriage might promote phthisis, from sexual imprudence in either sex; while in the female during pregnancy it might be, and usually is, *checked*, but after the child is born the tubercular deposit is increased, and also the softening.

Seventeenth Question.

Is Consumption caused or promoted by Inordinate Sexual Indulgence?

This question is one which, from its very nature, must be very difficult to answer. We must depend for its perfect solution upon not only the utmost skill and penetration on the part of a physician, but likewise for perfect certainty, upon the voluntary confession of sufferers, and confession, too, on a point which is rarely alluded to by any one, even to his most intimate friend. In fact, a perfect knowledge on the subject presupposes not only a species of confessional such as, it is true, sometimes exists between physician and patient, but likewise it requires great wisdom on the part of the prac-

titioner, not to be led by the self-accusation of the patient into a belief of the influence of this cause as a chief element in the production of the disease actually existing. Believing as I do, that there are very rare cases in which there can be little or no doubt of the importance of this cause, I hoped to obtain some facts to elucidate the whole matter, and therefore the general question was asked.

The table resulting is as follows, and certainly it seems to prove that the question was not without point in the estimate of our correspondents.

	Yes.	Yes; also onanism, &c.	No.	Doubtful.	Unanswered.	Totals.
From Massachusetts, .	91	3	12	9	28	143
elsewhere, . .	56	2	4	2	3	67
	147	5	16	11	31	210

One is struck with the small percentage of correspondents who are doubtful,—11 out of 210, or 5.23 per cent.; and also of those who do not vouchsafe a reply; 31 out of 210, or 15.23 per cent. The few who categorically answer "nay" is small, viz., 16 out of 210, or 7.61 per cent. And finally, we may notice the large proportion who believe that this over-indulgence or a vicious habit are promoters of consumption, viz., one hundred and fifty-two out of two hundred and ten (72.38 per cent). I cannot help commending this result to the serious consideration, first, of the wild, thoughtless and licentious; and, second, of all who think that marriage absolves from careful attention to the laws of health in this particular. And here may be laid down one general rule that must be true, viz., first, that when there is no healthful vigor of body and mind, but rather the reverse, after indulgence, extreme prudence should be the guardian of the family relations; and, second, that when extreme lassitude, nervousness or any special *malaise* follows such indulgence, either great abstemiousness or total abstinence for a time should be inculcated, until by proper regimen or treatment the healthy condition of system is regained.

Extracts from Correspondents' letters relative to this question.

Stone.—Overwork or mental trouble, or immoderate sexual indulgence, especially self-abuse, may at times be a cause.

Greene.—Onanism is a cause.

Harlow.—I am well satisfied that inordinate, or even moderate, sexual indulgence has a tendency to develop tuberculosis.

Packard.—Consumption is a mental disease arising from the improper relations and bad conditions of our social marriage system,—the same as all the forms of intemperance. It is the result of an overactive cerebellum excluding the higher faculties of soul, life and will-power. Hence a premature decay of the whole being. It is preëminently a hereditary disease,—self-begetting and self-sustaining.

Hammond.—I think this a cause of the disease. Whatever tends to debilitate the general system exposes the individuals to those diseases to which he is predisposed. There is a vital elasticity in the animal system which causes the system to recover itself from abuses, but the elasticity is greatly impaired by too frequent use. There are many of those causes mentioned in your circular that seem to act no part in the production of consumption, but, to those hereditarily disposed, would act a very important part. Hereditary predisposition to any disease does not necessarily doom the individual to death from the disease to which he is predisposed. For, by avoiding those causes that would tend to develop the complaint to which he was predisposed, he would die of some other disease. That some persons are hereditarily disposed to consumption there is no question in my mind. Although there may be no particular indication in early youth, yet, when the system becomes developed, and the functions of the organs of generation come into operation, then a drain is produced upon the system that brings with action the latent disease.

Sanborn.—Married people should be advised to occupy separate sleeping-apartments, except, perhaps, semi-annually. And children should be kept so busy at work or play, that they would be tired enough to sleep soundly through the night. They should be furnished with suitable employment, a portion of the time, with pleasant reading, music, light games, &c., so as to leave no time to learn, or learn of, pernicious habits and customs until they arrive at maturity, and then taught to avoid them as they would a tiger. Tobacco is another cause of consumption; worse, if anything, than rum.

Manson.—Yes; also by onanism.

Bullard.—According to my observation there is almost always a hereditary influence; but that solitary pollution and inordinate sexual indulgence have as much, if not more, to do with its development than any, or perhaps *all*, other causes.

Eighteenth Question.

Is Consumption ever caused or promoted by contagion or infection?

Under the light of modern investigations as to the inoculability of tuberculosis, the question of communication of the disease from one person to another, becomes a vital question. Dr. Budd, of Bristol, holds that the dried sputa have particles in them of the real "*contagium*" of this disease, and that they must be floating about in every atmosphere in which a consumptive is living. He lays great stress on this matter of communication of the disease in that numerous class of cases, usually attributed to a hereditary tendency, and where the disease runs through many members of a family.

Deeming the question thus important, the views of our correspondents become deeply interesting. Their answers, let it be always remembered, are grounded on their own every-day experience, and not on books.

The table runs thus, and we are at a glance struck with the difference between the views of correspondents on this and on the preceding question. These views are less decided. There are less in favor of, and more against the proposition, while the number of skeptical has increased.

	Yes.	Yes; occasionally, when under really favorable circumstances.	No.	Doubtful.	No answers.	Totals.
From Massachusetts, .	70	4	31	18	20	143
elsewhere, . .	30	6	14	9	8	67
	100	10	45	27	28	210

One hundred and ten out of two hundred and ten, or 52.38 per cent., answer affirmatively; while forty-five (21.42 per cent.) answer "Nay." Twenty-seven (12.85 per cent.) are doubtful; twenty-eight (13.33 per cent.) make no reply.

Evidently those who believe in the contagion or infection are not so numerous or so sanguine as they are upon some other questions submitted to them. May not the fact of the hitherto

great prevalence of the opinion of the non-contagiousness of this disease among English and American practitioners, and our strong belief in the hereditary character of it, have led us all to ignore what may, after all, prove a potent cause, and which we shall recognize on more close inspection? The question is of much importance. Physicians should be prepared to give directions as to the use of the same bed or chamber by consumptives and members of their families, or by their friends. I must defer a more elaborate statement on my own part, to a subsequent paper; but I will say that I have, for years, always endeavored to prevent any one from sleeping with a consumptive. If possible, I prefer the patient should be in one room, the attendant in another; with the door open between them, perhaps; but I never allow any one to sleep in the same bed with the consumptive. I direct that the attendant should not only thoroughly ventilate the room or sleeping-chamber, but that, each day, the attendant should walk or drive out a sufficient length of time to enable him or her to get pure air in abundance.

Extracts from letters from Correspondents relative to this question.

Chase.—From inhaling the breath of another, &c.

Hathaway.—Yes; after measles, typhoid diseases, &c.

Wilcox.—Healthy husband or wife by continued exposure from the other.

Nichols.—I think a child, free from all hereditary taint, might contract the disease by sleeping with a person having consumption.

Chapin.—I think in two families hereditarily disposed that it was produced by contagion, in some of the members of each family and their kindred.

Brown.—I have sometimes thought it contagious or infectious, particularly in members of the same family living together, and exposed to the same influences.

Gott.—A husband, not predisposed by hereditary taint, died of the disease apparently caused by taking care of his wife during her sickness. The wife also apparently contracted the disease while taking care of a brother. I have seen several similar instances appearing to originate from contagion.

Breed.—I have seen cases where the disease seemed to be developed by close contact, as in cases of husband and wife, or sisters habitually using the same bed, while in one of them the disease was fully developed.

Brown.—I am more inclined than I was at one time to attach importance to the influence of contagion. In two cases which have come under my notice the disease seems to have been communicated from husband to wife, resulting fatally in a short period in both cases.

Ward.—Perhaps persons much with consumptives,—rooming and sleeping with them,—are much more likely to contract the disease. I think such cases have several times come under my observation.

Smith.—I have now under my care a lady,—widow,—whose husband died of consumption. No hereditary influence predisposed to phthisis, but from *intense grief* lowering vitality, or from *materies morbi* derived from husband, or, as is probable, both causes acting together, she contracted phthisis. She has hemorrhage and tuberculated lungs, and probably will die before many months. Before the death of her husband, three years since, she suffered severely from whooping-cough. First hemorrhage about a year since.

Calkins.—In very many cases, I have the opinion from my own observations, that consumption is communicable by contagion or infection. The cases of persons attacked after exposure have been those who have been confined with the sick, in small, ill-ventilated rooms, or where the persons exposed *have slept with the sick for some time.* In several instances, persons who have no hereditary tendency to tuberculosis, have been suddenly attacked with all the phenomena of phthisis after full and continued exposure. My observation has continued for a period of twenty years, most of this time in Hampden County, Mass.

Blanchard.—An interesting case occurred here some years since, in which consumption seemed to be promoted by contagion. The case was that of a young wife who never had a child. During the sickness of the husband with consumption, the wife was constant and assiduous in her attentions, remaining much of the time in the sick-room, and notwithstanding the remonstrances of friends, sleeping there at night, and (during at least a portion of the time) in the same bed with the invalid. There was an inherited predisposition to consumption, her mother having died of that disease, but there was no special manifestation of it, in her case, until after this continued contact. After the death of her husband it rapidly developed, and she succumbed to its ravages. Making due allowance for the effects of anxiety and grief, it always appeared to me that contact and infectious air had a large share in the development of the disease.

Rice.—I am a firm believer that consumption is a contagious disease, much more so than is generally believed. I have in my mind several cases where there was almost positive evidence of contagion. Mrs. J. C. M———, a lady about sixty, died last spring, after having the disease two years. Her husband, before she was taken sick, was a perfectly healthy man, with sound lungs. He took care of her, slept with her, and nursed her. Soon after her death he began to cough, and went rapidly down with consumption. There have been no cases of the kind in his family for two generations. I believe he took the disease by infection.

Bullard.—I know of two instances of the wife's taking the disease by sleeping with her husband, and when the wife had no hereditary taint.

———.—I believe that consumption is caused or promoted by contagion, or infection; so perhaps a better word would be *ingrafting of pulmonary tubercle*, and it is to avoid this that I would have a child, already predisposed to the disease, removed entirely from its influences. I think that many physicians, if not most, know cases in their practice where the nurse of a consumptive patient has died of tuberculosis within a short time. Case: Miss ———, aged 34, a strong, healthy, fleshy woman, weighing upwards of 140 pounds, no consumption in the family, nursed Mrs. B——— during a long sickness,—tuberculosis,—which continued nearly two years from first attack. It was noticed that she had a slight hacking cough during the last of her attendance, but no particular notice of it was taken at that time. Evident signs of tuberculosis were found shortly after the death of Mrs. B., and within eighteen months she died of well-marked consumption. I have seen other cases, but none as well marked as this.

Knight.—Yes; under very favorable circumstances.

Carbee.—Yes; by constantly inhaling fetid breath.

Hopkins.—I have left the question unanswered. If consumption does occasionally follow close upon whooping-cough, or measles, it is probably an open question whether the impression left by the specific contagion were, itself, the predisposing cause of phthisis, or only the exciting cause of a predisposition before implanted. I have thus offered what is suggestive, not statistical.

Carr.—Yes; as a sequel to contagious disease. It sometimes follows virulent clap, and where there is hereditary taint, frequent miscarriage induces the disease. Everything which has lowered the vital forces below a certain degree, whether our habits, location, sickness, exposure to sudden atmospheric changes, or any other debilitating influence, promotes the development of consumption in a person springing from consumptive parents.

Butler.—There are well-authenticated cases on record (see Amer. Jour. Med. Sciences, 1871) which seem to favor strongly the idea of its contagious nature, but my opinion is not fully settled, though I am inclined to the belief that, under certain favorable circumstances, it may be communicated from one person to another.

Heath.—A family which I have occasionally attended as physician has had, within the past two years, four children between the ages of eighteen and thirty-two return home to die of consumption,—one from Ohio, two from New Jersey, and one from Connecticut. The mother is healthy; the father, now at the age of seventy, is able to labor on a farm, but has been troubled with a bad cough for many years. The most intimate relations and favorable conditions for contagion or infection exist between husband and wife, but I have never known a case to be so communicated.

Gavin.—I am thoroughly convinced that phthisis is frequently caused by contagion, and deserves to be classed with typhoid fever in this respect. I have seen unmistakable evidence where a healthy wife contracted the disease—phthisis—from sleeping with her husband suffering from that disease, and vice versa. So much am I convinced of the truth of this statement that

I always forbid a healthy man from sleeping in the same room with a phthisical patient.

Wilmarth.—I can mention one marked case. A lady, mother of three girls, belonging to a family apparently free from consumption, became consumptive when the oldest girl was eight or ten years old. She lived about ten years in a consumptive condition. During the last three years of the disease her oldest daughter was her constant attendant and nurse. The breath of the patient was offensive, and she raised large quantities of thick sputa, which had the same offensive smell as the breath. About a year after the mother's death the oldest daughter went into consumption, and presented the same symptoms that her mother did, except that in her case the disease ran its course in a few months. Her death occurred about four years ago. The younger sisters, who were not so much with their mother as the older one, are now living, and apparently well.

Jordan.—We very often see one healthy individual who, in the habit of sleeping with a consumptive, follows with the same disease.

Nineteenth Question.

Is Consumption ever caused or promoted by an exposed location of residence?

The table gives the following results :—

	Yes.	No.	Doubtful.	Unanswered.	Totals.
From Massachusetts, ...	85	24	7	27	143
elsewhere, ...	44	14	–	9	67
	129	38	7	36	210

One hundred and twenty-nine of the two hundred and ten (or 61.42 per cent.) think the exposure of a residence may have some effect in this disease, and thirty-eight (18.09 per cent.) deny the fact. Seven (or 3.33 per cent.) are doubtful, and thirty-six (or 17.14 per cent.) do not answer.

One cannot say that the cause seems to be a prominent one, in the eyes of the majority of our correspondents.

I used the expression "exposed" in order to find, if possible, if the simple exposure to violent atmospheric changes, from the situation of the homestead, tends to promote consumption. The question is in contradistinction to the next

question, which has reference to the effect of moisture, and upon which we have no doubt, from investigations made in America and England. I think that my experience justifies me in saying that *simple exposure* rarely, if ever, causes consumption. But, when combined with moisture of soil in and around houses, it is a prominent fact in the annals of consumption in any community.

Extracts from letters from Correspondents relative to this question.

Ward.—Dwellings should be exposed to wind and sun.

Burr.—Consumption occurs as frequently among families who live on the ridge highland as in the other portions of the city.

Spofford.—If the ground is dry its situation near the water does not affect health. For fifty-three years I have lived near the Merrimac River; am eighty-three years old,—wife is eighty-one. Can mention seven near neighbors above eighty years. To these may be added, of three hundred deaths (in the course of the last few years) six, from eighty to eighty-seven; one, ninety-five, and another ninety-seven. In the present population, 1,600, there are now five aged ninety, and twelve between eighty and eighty-five.

Jordan.—Excessive exposure to heat and cold exert a great influence in producing the disease.

Aiken.—If to malaria, etc., yes; if to sun, etc., no.

Carbee.—Yes; by exposure to pernicious winds.

Eaton.—An exposed dwelling may promote it, especially if exposed to *damp* winds, when a *dry* exposed place might for a time, retard it. Thus is seen the difference between the climate of Minnesota and Iowa. *There* the weather seems as cold, and it is as windy as *here*, yet the atmosphere is dry there, instead of being moist as in New England. *There*, a new case of Phthisis Pulmonalis is rarely developed, yet many die who go from *here* with the disease far advanced. *There*, many times in cold weather, the air feels icy and frozen, as if coming from very cold water. Such air, of course, must be bad for the consumptive—such has certainly been my experience in practice.

Twentieth Question.

Is Consumption ever caused or promoted by a wet location?

	Yes.	No.	Doubtful.	Unanswered.	Totals.
From Massachusetts, ...	110	17	1	14	142
elsewhere, ...	58	4	1	5	68
	168	21	2	19	210

Upon this question the profession is more nearly unanimous, than upon most of those that preceded it. This is probably owing to the fact that investigations carried on in Massachusetts, many years since, by myself,* and subsequently, in England, by Dr. Buchanan, under the special directions of the Medical Officer of the Privy Council,† have fully proved that residence on a damp soil tends to the production and promotion of consumption, in New and Old England.

These investigations and these results have probably given an explanation to the prevalence of consumptive cases in the practice of physicians, which previously were less explicable.

The percentages are as follows: one hundred and sixty-nine (80 per cent.) take the affirmative; twenty-one (10 per cent.) the negative; two (0.95 per cent.) are doubtful, and nineteen (9.04 per cent.) have returned no answer.

Extracts from letters from Correspondents relative to this question.

Ward.—Dwellings should not be exposed to cold or dampness.

Brown.—I am more and more impressed with the influence of location, as

* Annual Discourse before the Massachusetts Medical Society, by Henry I. Bowditch, M.D., also Prefatory and Historical Remarks by the same author to "Consumption in New England and elsewhere, or soil-moisture one of its chief causes." 868, David Clapp.

† 9th and 10th Reports of the Medical Officer of the Privy Council. 1866-7. London.

determined by low levels and damp surroundings. I think that the use of cellar-kitchens in certain localities, is decidedly unhealthy.

Barker.—In exposed, wet, damp and foggy locations, the general health and strength suffer, and consumption is promoted.

Downes.—I have a patient, at present, who has two homes,—the one on a dry, sandy soil, the other near a large brook and pond. While at the latter, she coughs more, and invariably feels worse.

Torrey.—I have often seen consumption apparently checked by change of locality, by going to Southern or Western States where the atmosphere is dry. I think consumption is very much on the increase here (Braintree), owing to the moisture of the land. I think, also, it is owing to the occupation of a large portion of the inhabitants, being manufacturers of boots, and working in small, close shops.

Brigham.—Have attended two cases of consumption following colds contracted by moving into new houses before the plastering had become thoroughly dry.

Adams.—I came to Stockbridge thirty-three years ago. At that time and during the ten years following, there were in the village, several cases of consumption,—all young ladies from sixteen to twenty-five years of age. I heard then no opinions of the cause, except the habit, said to have been prevalent, of evening walks with slight protection. It seems to me that the evenings then were much more damp than they are now. For nearly twenty years I do not remember a case of consumption originating here. The plain is sandy, and the soil in the meadows on the banks of the Housatonic is so porous that the water filters through it and quickly reaches the river. Our village has been supplied, since 1864, with pure water from the mountain. Typhoid fever has been rare during the last five or seven years; previously, the disease was quite regular in its autumnal visitations. Drains and cellars receive proper attention, and care is taken to render them inoffensive.

Morse.—I am convinced that living in a valley near water is an active cause in producing consumption. But this, I believe, is universally conceded.

Metcalf.—Consumption is rather a rare disease (more rare, I think, in the last twenty-five or thirty years), in the circle of my practice; and oftener occurring in families located in exposed situations, and *especially if the site is wet.*

I would invite especial attention to the following letter:—

Huse.—The marked prevalence of phthisis in Georgetown, is undoubtedly due to the extremely moist condition of a considerable portion of the soil. The town being located at the intersection of two main roads which traverse a large area of fresh meadow-land, a large basin collecting the drainage of a large area of upland. The immediate centre of the town is of gravelly soil, quite pervious to water, and is quickly dry; but the south-east, south and south-west

portions are boggy and wet, inundated by freshets, and filling many cellars with dampness, if not with water. The meadows, like all others at certain temperatures, give many noisome and thick fogs, which completely envelope these portions of the town, only to be dispelled by the next day's sun, or a favorable wind. At these times, any one standing on the neighboring hill, can see only the tops of the most elevated buildings, which appear to come out of an immense cloud. The town is but little shaded, though considerable woodland is in the outskirts; but in the inhabited portion, the sunlight has free ingress. As in all basins, there are several ponds, of several hundred acres area in the aggregate, which, with the flowage of the meadowland, serve as a mill-privilege, thereby increasing the sources of dampness, besides being the cause of much litigation because of damages incurred by overflow of gardens.

Chamberlain.—The causes of consumption are sometimes past finding out, as the following circumstances will show: Two brothers living in this town, when young men, built themselves houses, not more than fifty or sixty rods apart; one built a wooden house, on a slightly elevated, sandy locality—the house is not shaded at all, but takes the sunshine freely throughout the day. In this he reared a family of twelve children, eleven of which are now living, the youngest being about thirty years of age; a part of the family still occupy the house, and no case of consumption has ever occurred in the family. The other brother built a brick house on a spot neither elevated nor low; the site is not wet, but is not as dry, and is a little less elevated than the point selected for the wooden house built by the first brother. Here he reared eleven children, and has occupied the house probably forty years. The house is considerably shaded on the south front. Within the last twenty years there have occurred, in this family, nine cases of consumption. Both of these houses front to the south, and both are equally exposed to the north-west winds. Consumption is not hereditary in either family, through father or mother. I know another family in which consumption is not hereditary, who occupy a house in which sunshine can scarcely enter, in consequence of shade-trees and the peculiar build of the house, which has lost six children by consumption. They all arrived at adult age, however, before disclosing symptoms of the disease. In regard to the mortality attaching to the brick house above mentioned, the shading of the south side cannot be considered a cause, as the disease first showed itself before the trees were large enough to shade the premises. I can call to mind several similar instances. My own conviction has been for many years, that consumption loves a moist locality and a dark dwelling. I have noticed that houses built upon a dry subsoil, and so constructed that they admit the sun freely, are generally free from consumption. A dry locality, with plenty of sunshine, warm clothing, and good living, will never breed consumption; with these blessings surrounding a person he may, even if he inherits a predisposition to consumption, keep the disease at bay, and live to a good old age.

Holmes.—Yes; and east winds and fogs.

Cushman.—It has been said in official reports, that in this town—Randolph—consumption is more prevalent than in any other town in the State. It will be difficult to account for the fact; Randolph is high and dry land. The land between us and the ocean is lower than it is in Randolph. The

east and north-east winds come to us loaded with decayed vegetable matter from the lowlands of Braintree and Quincy.

Wheeler.—I am quite positive, from well-marked observation, that dwellings situated on northern declivities, with low, damp lands below,—for example, a marsh or a meadow, either fresh or salt, to the eastward,—are peculiarly exposed to consumptive causes. I have seen whole families, so exposed, fade away in a few years, after having reached adult life, especially the younger members—the children more frequently than the parents. This I have observed in families where the children have been born and reared in the locality.

Greene.—Our little town has been more than usually afflicted by the dreadful disease to which the circular calls attention. One little hamlet on the banks of the North River, our principal stream, has four new cases. This village is very low, and is almost every night enveloped in a fog. A hundred rods to the north of this village is another case—a young mother with four children. This case is apparently an example of a variety of causes combining to produce the dreadful result—consumption. The causes in this case are (1), hard labor at cotton-weaving; (2), frequent child-bearing; (3), foggy air, muddy soil, and perhaps foul drinking-water—for the patient uses water from a spring which was often white as milk, with clay; and her abode is a factory tenement on the bank of a canal which supplies power to the mill she worked in. The soil is always damp there. I have one patient who contracted the disease while a "commercial traveller" in Michigan, a notoriously swampy State. One patient is the daughter of a woman who was cured of consumption years ago. I have this statement from her (the mother's) attendant, Dr. A. C. Deane, of Greenfield. Her mother recovered under the influence of change of air, exercise, and cod-liver oil. The daughter's disease followed (1), hard work at cotton-spinning; (2), wet location of home; (3,) pneumonia, right lung, which is now the seat of tubercle; (4), drunken habits of father; (5), previous tuberculosis of mother; (6), irregular menses. Two cases are children of a mother who died (as I believe) of leucocythemia; she certainly had anæmia, exophthalmos, and slightly enlarged thyroid gland. Both live in a foggy, wet spot. One case died of consumption, following, and complicated by severe chronic pharyngitis. This case was apparently made worse by child-bearing. A boggy pasture is in the rear of the house.

Mayo.—I believe a cold clayey soil develops consumption, from its exhalation of moisture, causing damp dwellings; with miasma from the soil, etc.

Manson.—I have observed, in two or three instances, where no hereditary taint existed, several children carried off by consumption; and where the homestead was situated on an elevated and dry situation.

Bullard.—A young man, aged twenty-six, with slight, if any, hereditary taint, living in a low, wet place, almost over a mill-pond, was taken with incipient phthisis. He was removed to a dry locality, and is now under treatment, and nearly free from any trace of phthisis.

Haskell.—Exposure, and sea-fog.

King.—I know a family living in a wet situation which I think has helped develop the disease. Without the hereditary predisposition I know of no

case occurring in wet localities, or caused by any particular work, or over-work.

Rice.—Low, damp, foggy situations engender and develop the disease. A person with consumption will die much sooner in such a situation than in a high, dry, airy location.

Wakefield.—A house exposed to damp east winds would promote, or at least aggravate and hasten its development.

Hammond.—Wet locations especially liable to cause it.

Hunt.—Damp, low and shady residences promote it.

Harris.—Inquiries that I had begun upon general sanitary questions in every town in the State of New York in 1859, as a Committee of the State Médical Society, prepared me to believe your opinions (viz., that soil-moisture is a prominent cause of consumption in New England, and probably elsewhere) were well founded, when you first mentioned them to me in 1862.

APPENDIX.

GENERAL ANSWERS NOT REFERABLE TO THE PRECEDING QUESTIONS.

Luce.—I have known one case, a young man, a close student and college graduate, who died of consumption, where there was no hereditary taint, but the parents were cousins.

Wakefield.—To sum up all, I should say that catarrhal symptoms often engender phthisis.

Hunt.—Crowded, ill-ventilated sleeping-apartments, sedentary employments, residences in crowded parts of the city. Warfare against dancing as an amusement for the young, insufficient clothing in cold weather, etc.

Bigelow.—Mr. and Mrs. M. had no tubercular taint, nor had their ancestors. Two of their three children were strong till after puberty, and then died of consumption. I can describe some other families with the same conditions.

Clary.—I have preserved no statistics of cases which have come under my notice, but will state some facts of my family history. My father, a clergyman, died of consumption, at the age of forty-nine: his father, a physician, died of consumption, at the age of sixty-five: an older brother of mine who had been quite vigorous and healthy while leading *an active out-of-door life,* after engaging in business in the city, confined to a store, and soon after, marrying, began to decline and died in about three years, of consumption, at the age of thirty: an older sister, *after teaching for some length of time,* began, at the age of twenty-eight, to decline,—had decided dulness at the upper part of left lung, with hæmoptysis. She left her school; went, in the fall of the year, to the home of a relative; took iron, etc.; lived well; rode out, at all temperatures; grew fat; and returned to New England the next spring, thirteen years ago; and has had, so far, comfortable health, in this respect; not married. Our mother belonged to a healthy and long-lived stock. Four other children (including myself) living active lives, are past middle life, with families.

Palmer.—I believe that "Consumption" is often the result of chronic pneumonia, sometimes of chronic bronchitis, and sometimes of hæmoptysis, &c. According to my observation primary tuberculosis does not occur in so large a proportion of cases as most authors (except the Germans) appear to teach. I have given much attention to this point within a few years past, and am very confident that in this locality (in Michigan) and also in Brunswick, Me., where I have observed and traced the history of cases coming

to clinics, very many originate in inflammation—perhaps it is safe to say, one-half. By "Consumption," I mean wasting disease of the lungs.

Aiken.—Belonging to a consumptive family on my mother's side, she having died of pulmonary consumption at thirty-two,—her parents died of pulmonary consumption under forty,—I have, myself contended with infirm health all my life. I was brought up in Boston from seventh to nineteenth year, under the high-pressure system of the Public Latin School. My father had two sisters, one of whom has had to fight for her life against consumptive tendencies. She has taken two voyages, one to the Holy Land and one to Australia, India, Egypt and England, but is now alive and still fighting, bringing up a family of four children, from seven to thirteen years of age. A country practitioner, now, these dozen years, I know whereof I affirm. The only survivor of my mother's family is sixty-five years of age. I am not aware that he has ever suffered seriously from pulmonary difficulty.

Adams.—The disease is rare in Pittsfield. A few persons die of consumption, but the majority of cases which come under treatment in an early stage are very readily cured. Persons suffering from consumption coming here from lower-lying districts are very apt to receive permanent benefit from the change.

Holbrook.—In a practice of nine years I have had in charge, at death or previously, some fifteen cases of tubercular phthisis. My records show me two cases for 1864, one for 1865, three for 1866, three for 1867, one for 1868, three for 1870, two for 1871. Two of these were in young persons who began to work early in life, and were, until disabled by sickness, still in a cotton-factory. Three elderly females had the disease certainly intensified, if not caused, by the hard, monotonous toil necessary in a large family. One young man brought on his consumption by overwork, both physical and mental, in carrying on a country store, aided by great irregularity in meals and sleep. Another young mother broke down under frequent child-bearing. The balance were apparently caused from hereditary taint. But as my practice embraces a large number of patients annually, during the last six years I have given medicine to from fifty to ninety a week. My opinion is that consumption is *not* a frequent disease in my circuit of practice. My preventive measures are chiefly hygienic, especially insisting on out-of-door employment.

Jordan.—Fashion lays the foundation for more consumption than all other habits combined. The efforts of mothers to produce abortion upon themselves is another cause; but this is a part of fashion.

Hunt.—Indigestion from improper food, too much meat and gross food in summer, too little meat in winter, with new bread, rich cake and pastry, all the year round.

Ballou.—One should endeavor to avoid having consumption arise in his family by marrying a healthy partner. Corsets and thin shoes, or whatever deteriorates the blood or destroys nervous sensibility, are causes of consumption.

Robbins.—Consumption is caused by every means which in any way lowers the vitality of any organ: First, bad air in sleeping-rooms; second, any im-

purity in air of a locality which predisposes to any disease whatever, especially that (whatever it is) which causes typhoid to prevail. I do not agree with Dr. Bowditch's dampness theory; think it is the impurity associated with the dampness, rather than the dampness itself, which predisposes to consumption. I am certain that fogs which prevail on the eastern coasts of Maine and in Nova Scotia do not give rise to it, while I feel equally certain that those occupying dwellings on marshy or ill-ventilated localities, or on the sides of fresh-water streams whose beds are left dry, or partially dry, in summer, opposite the prevailing winds, are peculiarly liable to it. Third, changes in weather causing irritation, congestion and flabby condition of air-passages. Therefore, improper clothing and poorly-warmed houses. Fourth, poor or restricted diet, lowering vitality of blood, or deranging digestive system. Fifth, any cause whatever, predisposing to dyspepsia, e. g., bad cooking, wrong use of tea, coffee, tobacco, stimulants of all kinds, absorption in business, mental unrest, eating when weary, too many meals, too few meals, too hard work after meals, &c. In consumption I think one of two things must precede, either a *low chronic pulmonary inflammation* caused by exposure, or *dyspepsia.* I am inclined to the belief that dyspepsia must come first, or some degree of it, for I can hardly conceive of a case of consumption where the patient always had a good stomach.

Hopkins.—That consumption occasionally is, and often may be prevented from occurring in children hereditarily disposed, I have no doubt. I believe the especial means to this end are not one, nor few, but many; and that their *combined* action is, in general, essential to the attainment of the end aimed at. Foremost among these, I judge, should be placed what may be termed *discouragement of hereditary habit.* I mean by this that if the parents of the individual have attained the peculiar physical habit that tends to the deposit of tubercle under certain given conditions, social and professional, the children should as soon as possible be transferred to conditions that shall bring into habitual exercise other qualities, i. e., conditions contrastive, and therefore re-active as regards the inherited crasis, e. g., that which is by inheritance intellectual and luxurious may, while duly watched and nursed, be educated over to that which is physical and hardy. The same contrast from native conditions can be measurably carried throughout the social scale. There can be no more potent alterative of temperament and nutrition than this. And as to climate, the systems of these individuals are so impressionable that much is often attainable by mere transference from city to country, from valley to highland, &c. But these stages are requisite *early* upon the first *suspicion* of taint. The remark of a musical artist to an accomplished pupil whose studies were completed, "Now go and learn the cooper's trade" is in point here. The second great means upon which I beg leave to touch is, a more happy and thorough dissemination of physiological theory; a better indoctrination of families and schools in all those great principles upon which are based the laws of health, and upon which the physical structure of society will rest whenever the members of society shall be generally intelligent on these matters. Physicians, both in the family and in the community, have great opportunities here which are sadly ignored by too many. The texts-books in physiology adopted by most of the schools are unsatisfactory. But in the *family*, not in the *school*, must we look for the pursuit of that good study, and for the fruit of it. I am persuaded that most generous and universal use of milk and of unbolted cereals is of cardinal importance, and, if habitual, would be of inestimable value in

conjunction with meats and the saccharine fruits and with butter. Pastry should be excluded. It is possible, too, that cod-liver oil has been too long acknowledged as king; and that it will serve better as adjuvant. In a case not consumptive in which digestion and assimilation were extremely imperfect, I have found so much satisfaction from the use of pepsine and lactic acid, combined with soluble citrate of bismuth and sirup of orange-peel, that I am induced to allude to it here, as being a digestive agent worthy of trial in cases that can afford the expense. Another suggestion is, the adoption of means for inducing ozonized oxygen in apartments and localities. It seems abundantly proven that simple ventilation, at least in cities, does not supply a feeble organism with its requisite atmosphere. But the air becoming, as it were, vivified by ozonization, becomes at the same time disinfected of whatever may have been deleterious. The contribution of well-regulated and restrained athletic sports toward the end now discussed, needs no more than an allusion. The universal *croquet* tempts to its pursuit in low-necked dress and thin slippers after dew-fall; I know of no other objection to it. Questions nine to eighteen have all reference to influences of an exhausting nature, and might, with more or less qualification, all be answered in the affirmative.

The following, from an eminent London physician, I have been unwilling to divide under the different questions:—

Third question: In a large family, a member of which I passed for insurance, where the hereditary tendency existed in both parents, the elder children, being poor, had to rough it, and remained healthy; while the younger, having meanwhile become wealthy, were coddled, and so became consumptive. In another case a sea-life appears to have checked an early tendency to tuberculosis of lungs.

Eleventh question: Dry grinding produces fibrous phthisis—"grinder's rot." Wet grinders do not seem to suffer, at Sheffield.

Tenth or twelfth question: The most pernicious overwork I know of in respect to the production of phthisis, is that of the Cornish lead-miners, who after their day's work, have to climb an exhausting number of ladders. They become consumptive in ordinary pits; but where a "man-engine" is used they are preserved.

Fourteenth question: The most frequent of all causes among all classes in such a population as that of London, and probably the most powerful cause, for it acts even in spite of hereditary health. The course of events connecting sorrow of mind with disease of body, would seem to be—slow breathing, defective innervation, and consequent weak action of the heart, slow circulation in the stomach, imperfect supply of gastric juices, anæmia, malassimilation of fibrine, formation of tubercle.

Fifteenth and sixteenth questions: A balance is struck; pregnancy seems to check, child-birth and suckling to hasten consumption.

Seventeenth question: No; harlots are healthy.

I hope, Dr. Bowditch these answers are what you require. I do not exactly see what action a State can take in the matter, except by assisting everybody to be as wise, joyous, prosperous, as well fed, and as pleasantly situated as circumstances will admit. Perhaps they might in addition make celibacy compulsory in ascetics in order that the anæmia of parents may not produce tubercle in the children (see "Galton's Hereditary Genius"). But I suspect

that would be too violent an infringement of personal liberty for Massachusetts.

The following comes from a well-known physician in New York :—

Parker.—Third question : Such means as are essential to a perfect state of health—first, such food as makes perfect blood, as milk ; second, breadstuffs ; third, ripe fruits ; fourth, meats. These must be taken in proper supply and at definitely prescribed periods. Where more is taken than is perfectly digested harm is done. When taken too frequently harm is done ; that is, an imperfect digestion is the result. Again, the *health balance* must be maintained ; if a given quantity is taken into the system every twenty-four hours, an equal amount must be excreted, or thrown off from the system ; otherwise, effete material remains and the balance is disturbed. The effete material is worked off by the *lungs*, the *skin, kidneys, &c.* A pure and dry air the lungs *must have* in order to perform their part of the work. The skin must be clean, and active physical exercise is essential to the healthful physical working of all,—lungs, skin and kidneys.

Fourth and fifth questions : Yes ; any circumstance unfavorable to the soundness of the system tends to induce consumption.

Sixth question : In some cases of strongly-marked consumptive diathesis it is overcome by alcohol, and the alcoholic diathesis takes its place, and life, such as it is, is prolonged.

Eighth question : There are cases of incomplete digestion in which consumption tends to occur. Now in these a *limited* amount of brandy or rum, taken *with* the food as *kindling material* in starting a common fire.

Sixteenth question : Child-bearing checks for a time, but does not cure. During gestation and lactation the appetite is often good and the digestion perfect.

Nineteenth question : Exposed locality of dwelling to sun and air, and on diluvial soil, is anti-consumption. I have very little confidence in any medication. Air, sun, and all the muscular exercise the patient *can endure ;* if these induce appetite and digestion his chance for improvement, if not for recovery, is good.

This comes from one equally eminent resident at Chicago :—

Davis.—First question : I have no doubt but that consumption is often the direct result of hereditary influence. Third question : I am also fully of the opinion that children so predisposed can be made healthy, and avoid the disease by special physical training, begun young, and continued through active life, aided by dry, pure air. Fourth question : I am also fully satisfied that the habitual use of alcoholic drink, whether to the extent of drunkenness, or not, favors the development of consumption, both in parent and child. Several years since, I examined this subject carefully, and for six years kept records of cases and facts relating to it, the results of which I communicated to the Illinois State Medical Society several years since. I do not think total abstinence has any marked influence, except as it may be associated with good air, proper exercise, and food. In regard to questions nine to fourteen, I should say that consumption is rarely, if ever, caused by simple excess of mental or physical labor, but the confinement and over-

crowding of schools, neglect of physical exercise by students, the confinement and bad air in which some trades or occupations are carried on, undoubtedly cause a very large number of cases of consumption.

Seventeenth question: Excessive sexual intercourse or inordinately rapid child-bearing, like any other causes of debility, might hasten the development of consumption where the predisposition exists. Eighteenth question: The facts relating to the question of contagion or infection are so contradictory that I hardly have a positive opinion regarding them. Nineteenth question: If you mean by "exposure" of dwellings locations freely exposed to winds, and isolated, I think it has little, if any, effect upon the production of this disease. Twentieth question: Wet localities, damp rooms, damp air, and insufficient or imperfect exercise of the muscles of the chest and trunk of the body, are the most prolific causes of consumption.

The following letter from Dr. Manson, of Pittsfield, suggests important considerations in regard to the effect of diet, and especially of the free use of pork, even when swine are raised upon the farm where the family resides, and where the animals may be supposed to have been fed in the best manner. At any rate we may believe that they are not slaughter-house cattle, nor wholly offal-fed. But still more do I think that the three families tend to suggest the idea of the influence of contagion, or perhaps of improper food; and in support of this view I refer to Dr. Manson's second letter of later date, written in answer to one from myself, asking further information on the subject:—

PITTSFIELD, Maine, August 6th, 1871.

DR. BOWDITCH: *Dear Sir,*—I know of no better way to answer your inquiries than by relating, to the best of my recollection, the histories of certain families which have come under my professional observation. First, the family of S. J———, Esq., living in the town of P., came under my care some fifteen years ago. Mr. J. and wife were both from hardy pioneer stock; both living at the present time. Their parents, on both sides, lived to a good old age, according to the best information I can obtain. Said J.'s family consisted of three sons and five daughters. The eldest son died before my acquaintance with the family, I *believe* of consumption; both the other sons are now living in the State of Minnesota, I think, where they went years since on account of irritable lungs. They visit this State occasionally, but are feeble men, strongly inclined to phthisis, due I believe, to the incipient stage thereof. The daughters were named respectively, Mary, Lucia, Lizzie, and Martha. Lucia, first, after two years' suffering, died of consumption aged about twenty-three. Lizzie began to falter somewhat before the death of Lucia, but, in accordance with my advice, spent two winters—one in New Jersey and the other in Tennessee—with apparent benefit; lived some four years, and died aged about twenty. Two or three years subsequent to the death of Lizzie, Martha sickened in the same way, and died in about one year, aged about eighteen. About this time Mary, whose health had been, for some time, poor, began to fail rapidly, and died in about one year, aged

about thirty-five. *Location.* The house was on a hill, where all the surrounding surface was high and dry—much more so than their neighbors'—no unusual dampness in the cellar, drainage good all around; house large, two-storied, high-posted; rooms large and airy. Mr. J. was an independent farmer, worth some eight to ten thousand dollars; seemed anxious to do all he could for his family; had a *good orchard,* with *plenty of fruit,*—diet same as farmers in the State usually have. Their animal food consisted principally of *pork* of his own raising; family always comfortably clothed, the general surroundings were such as to conduce to happiness, nice flower-garden, etc., etc. The north and west sides of the house were protected by tall fir-trees, some thirty or forty feet in height, with thick foliage standing quite near the house—an artificial evergreen forest. How much this might serve to keep the back side of the building damp after a storm, might be a question.

The following table shows at a glance the history of the deaths by consumption in this family:—

S. J. & wife, both hardy pioneers, and their parents were long-lived.	1. Son; think died of consumption. 2. Son; now living in Minnesota, where he went because of an irritable state of the lungs; he visits here occasionally; is a feeble man, strongly inclined to consumption. 3. Son; believed to be in the incipient stage of consumption. 4. Daughter Mary; d. of consumption, æt. 35, after about a year's illness. 5. Daughter Lucy, d. of consumption after two years' illness, æt. 23. 6. Daughter Elizabeth, d. of consumption, æt. 20, after seven years' illness. 7. Daughter Martha, d. of consumption, æt. 18, after one year's illness. 8. Daughter.

All the sisters occupied the same well-ventilated room; but they successively took care one of the other.

Second Family.

Wm. C. P—— and wife, both living, aged about 55. The father of Mrs. P. is living—88 years old—smart and active; can split wood, care for cattle, &c.; says he never was sick. The mother of Mrs. P. died some four or five years ago, of old age, about 82; had suffered but very little from sickness during her life; had borne some twelve children, most all of whom are now living, *none having died of consumption.*

The father of Mr. P. was a tough, hardy man, never sick; died accidentally, aged about 60. His wife lived until some five or six years ago, and died of old age, nearly 90.

Wm. C. P. had six children, but one of whom is living,—*all died of consumption.* The eldest, a daughter, now living; married; has borne one child; is now in incipient phthisis; she is some 30 years of age. All the rest died between the ages of 16 and 22.

The house is situated upon *sandy* soil, at about the same elevation as those of his neighbors, a little higher than the village near which he lives; situa-

tion quite pleasant; soil so sandy that 'tis never wet, even during a storm; cellar was, as he says, never known to be damp—so dry, in fact, that the fine sand on its bottom has been so like ashes, and so troublesome, that he has sincerely contemplated cementing it on that account. Has always been in comfortable circumstances, having inherited a farm from his father, a very parsimonious man; family has been comfortably clothed, and fed from the farm. Animal food used has been, like the former, of *pork of his own raising;* varieties or extras never found their way to his table.

Tabular Summary.

	Children.	Grandchild.
W. C. P. & wife, both living, æt. about 55. Both of the parents of each lived to old age, strong and hale.	One daughter in consumption now,	"
	All the rest (five in number) died of consumption between the ages of 16 and 22.	
	The family lived on a dry soil; had little variety of food; meat consisted chiefly of pork, from swine raised on the place. The sisters slept with one another.	

Third Case.—W. S——, of this town, a hardy, tough man, living, aged 65; wife about the same age, died a year ago of consumption; a very hard-working woman, with no hereditary taint on either side; seven children; all but two have died of consumption; they are the youngest, but are now suffering from the same disease, aged 18 and 24. This family has lived until within a few years in comparative poverty. They may not have really suffered from the *quantity* of food, but I think they have from the *quality;* they have been coarsely, sometimes scantily, clad. The *meat used by the family has been pork.* The house is situated on the top of a hill, higher than more fortunate neighbors; location quite dry, but perhaps not *so* marked in this respect as the two previous ones, yet not wet; is dry more weeks of the year than most of their neighbors'. Deaths have occurred between 18 and 30 years of age. Two daughters have married and have children.

These three cases occur to me at present as striking examples of phthisis occurring in dry and elevated localities in the absence of hereditary tendencies. One fact I should have stated; viz., that Mrs. J. and Mrs. S. were *very hard-laboring* women, *particularly so during maternity, overtasking themselves* almost *daily,* as they acknowledge. Possibly this may account in part for the feeble constitutions of the children.

I subsequently wrote to Dr. M. asking more details in regard to the situations of the houses of these families, &c., and received the following reply:—

I have gathered some *facts* concerning your inquiries, believing that theory—hypothetical—had governed full long enough. I have lately visited the family of W. C. P., of whom I wrote you, and found the cellar *just as represented, dry like ashes—sandy*—never known to be wet soil around the buildings—sandy—perfectly dry. Mrs. P. gives the following history of her family—prefaced, however, with the assurance that consumption is, and was unknown in her father's family, and also in that of her husband. 1st. Her eldest son died, in the West, from diseased lungs, aged twenty-four; as she could not see him after he sickened, she can tell but little concerning the

case. 2d. S., daughter, who commenced to fail, when sixteen, and died at twenty-two, being sick during the whole interval. 3d. F., daughter, died in nineteenth year, after two years' sickness: P., son, died, aged 18, after one year's sickness: I., daughter, died, aged seventeen, after two years' sickness. The sisters slept with each other to quite an extent, but in an open chamber, *well-ventilated.* P., always, or for years, roomed alone, and practised sleeping with windows lowered at the top. The mother feels sure that none of her children suffered from masturbation. When young were strong and healthy. All wore flannel next the skin—*home-made*—the greater part of the year—had *plenty of pork and mutton, with milk, butter and eggs, more or less fruit, etc.* Diseases, in each case, seemed to commence in the *throat.* Lost much strength and became emaciated, in each case, before commencing to cough or expectorate; a great similarity in all the stages of each case. In case of J. family, the sisters each cared for the other successively, and as near as I can learn, occupied the same room, *well-ventilated* and *large*; further than this I can add nothing concerning them to my former report. The S. family cared for each other, and probably some two occupied the same room most of the time. I long since embraced the opinion *decidedly* that consumption *can be communicated,* and in fact, is quite likely to be, where one occupies the same bed with a consumptive. A striking illustration has lately come under my observation: the patient died last week. He was born in Scotland, of hardy parents who moved to this country some eighteen years since. His mother gave me the following history:—

"I am sixty-four years of age; my husband is living, aged sixty-six; neither of us has ever been sick; have seven children, all hardy; never heard of consumption amongst the family connection, on either side. Robert (deceased) was thirty-three years old—boss-weaver in woollen-mill—always *hardy* and *tough*—married a Yankee, about three years ago—wife was sick when he married her—*her family was consumptive.* She had cough—after a few months, night-sweats, bad. Told Robert to sleep in another room, but he said he would not leave her. In fifteen months she died. About six months before her death, Robert began to lose his appetite, and falter. I tried again to persuade him to take a separate room, but he would not leave his wife until about three months before her death, when it became necessary to employ watchers. He had then commenced to cough and sweat nights; and constantly failed, till last night, when he died. He was a strong constitution man until he took sick."

One more case on this point: Mr. G., of a family of six children, *all* hardy —no consumption amongst connection—married a wife from a consumptive family; who, after a few years, sickened and died, after about eighteen months' illness. Mr. G. occupied the same room and bed during the first year of her sickness; his health then commenced to fail: got a cough—soon, night-sweats—and died, some six months after the death of his wife; his being the only case of the kind in his father's family. This case occurred early in my professional life, and made a decided impression upon my mind. Other cases I could enumerate, but these may be sufficient cause for my opinion as to the *communicative* quality of the disease.

I will mention that, in conversation with Mrs. P. as above, she remarked that *scarlet fever* and *diphtheria* were the causes of the disease in her family. As I attended them through these diseases, and knew that the same neighborhood was generally afflicted with those diseases at the time her children were—and some were much worse—I asked her why her neighbors' children

were not affected in the same way, some of whom were more severely attacked with those diseases, than her own children. She answered, "I cannot tell."

Now, my dear sir, I repeat that I am firmly of the opinion, after about twenty years' observation in this *consumptive district*, that this disease is *surely communicable*, and it would be almost impossible to convince me to the contrary. Concerning the *original* exciting causes I am at a loss; am sometimes inclined to blame scrofula for the whole thing, and if you, my dear sir, are satisfied that scrofula can be propagated by *inoculation*, why not by *inhalation?* I believe it is so produced by inhalations of exhalations from the lungs and body—but this opinion is somewhat timidly expressed by an obscure country practitioner, striving for reliable information in any matter conducing to the physical betterment of suffering humanity.

In *connection with the use of pork*, I submit the following statements from Rabbi Dr. Guinzburg, a gentleman well acquainted with the various congregations of Hebrews in this city. Under date of October 29, 1872, he writes, in answer to some questions I proposed to him, the following replies :—

1st. The number of Jews living in Boston, is about 5,000.

2d. There certainly have not died of consumption, during the last five years, more than eight or ten Jews in the various congregations.

3d. It is very seldom that any Jew eats pork.

Dr. G. adds, "In order to give you as good information as possible, I did not rely upon my own knowledge, but made particular inquiries of those whom I thought able to give me good information upon this subject."

If Dr. Guinzburg's data be correct, they show a very great immunity from consumption on the part of the Jews, compared with the citizens generally, as will be seen by the following comparison between these numbers and those procured from the Registration Reports published by the State. In the Report published 1869, page 64, we find that, for the five years preceding 1869, the annual average of deaths by consumption, was 338 for every 100,000 living. These data from Dr. Guinzburg and the State Report, give the following table :—

	Proportions of deaths to 100,000 living.
All religions,	338
Jews,	40

These statements from Dr. Guinzburg are confirmed by the following letter from Dr. A. Haskins, of this city. Dr. Haskins is connected with one of the Jewish benevolent associations for the benefit of the sick. I sent to him similar questions and make the following extracts from his reply :—

"I am generally employed in about sixty (60) families (Jewish). I have had these families under my care for two and a half (2½) years. During this time I have seen but one (1) case of consumption. I have averaged among these sixty families, about two visits daily. In my other Jewish practice, which is not inconsiderable, I have in this time (2½ years) seen two (2) cases of consumption. * * * * I am sorry I have no statistics whereby I could compare the two peoples (viz.: Jews and Christians). I can, therefore, give you only my impressions. I should say that I find consumption less frequent among the Jews than among the Christians; this would be my own impression without any data to fortify it."

The following, from Dr. Waterman, also sustains the same idea :—

BOSTON, November 2, 1872.

DEAR SIR,—Excuse my delay in answering your note. I can give you no statistics, and fear that my information will prove to be of a negative character. I cheerfully give the following opinions, however. First, I have attended four charitable associations, numbering about 40, 50, 60 and 100 families. At present, I only attend one, containing 100 families, and on which I average a fraction over one visit a day. I have, besides, many private families among the Jews. Second and third questions.—I have attended but few cases of consumption, and I think the disease is not so prevalent as among Christians. I have seen some quick and rapidly fatal cases. Fourth.—The older Jews invariably abstain from pork, and most of the younger ones, especially those from Germany; those born in this country, also the English and Dutch, are not so strict, as a rule, in regard to this matter, nor in their observance of the fast and other holy days. I never knew a Jew to eat pork, *as such*, but I have seen them eat ham. I have met with two cases of tape-worm, in Jews, but know not whether the parasite came from pork, or beef, or other meat.

Truly yours,
THOS. WATERMAN.

Certainly, as it seems to me, these replies from Rabbi Guinzburg and Drs. Haskins and Waterman, indicate that consumption is rather rare among the Hebrews of this city. I cannot think that any physician in New England practising among Christian families, can make a report like that of Dr. Haskins, viz.: That in a practice so extensive as that which Dr. H. has had, and extending over two and a half years of

time, only three cases of consumption should have been prescribed for.

This apparent infrequency of consumption among the Jews, induced me to examine further, and a friend calls my attention to the fact that this people has not suffered from various diseases as other sects have. For example, they suffered, in the Middle Ages, but little from the plague: the epidemics of typhus in 1505 and 1824 troubled them but little; croup is also said to be rare. Boudin,* (from whom the above facts are obtained) gives the following for the relative liabilities of Schlaves, Germans and Jews, in reference to "plica."

29 ill, in 1,000 of Schlaves.
18 ill, in 1,000 of Germans.
11 ill, in 1,000 of Jews.

On the contrary, they are more afflicted with idiocy and insanity, in Denmark, as follows:—

3.34 insane or idiotic among Catholics.
5.85 insane or idiotic among Jews.

Unfortunately, Boudin says nothing in regard to their liability to consumption. This subject is altogether too wide for further remarks, at this time, but whilst these pages are in press my attention is called to the following facts mentioned by Dr. Stallard:—†

"The mortality of Jewish children under five years in Prussia is much less than of those in Catholic families. * * There is no hereditary syphilis, and scarcely any scrofula to augment the mortality. * * The mother undertakes no work that takes her away from her children. * * The average duration of life at Furth is twenty-six years amongst the Christians and thirty-seven among the Jews. * * At Frankfort, the Christians average thirty-six years and eleven months; the Jews, forty-eight years and nine months. In Prussia, the Christian population requires fifty-one years to double itself, but the Jewish population will double itself in forty-one and a half years.

* Traité de Géographie et de Statistique Médicales, et des Maladies Endémiques. Paris. Baillière, 1868, vol. 2, p. 141.

† London Pauperism amongst Jews and Christians, &c. By J. H. Stallard, M. B., London. Saunders, Otley & Co., 1867. London.

Wakefield.—Intemperance, according to my observation, causes death by apoplexy, hepatitis, ascites and anasarca, combined with hepatitis or erysipelas, &c.

Jarvis.—Some years ago when I was in practice, I had complete knowledge of all the ailments of a considerable number of families. I divided them, or rather their members, into two classes—the temperate and the intemperate —and compared their number of days of sickness for two or three years. I added to the intemperate sickness, all others caused by intemperance (as injuries to passengers, caused by overturning of stage-coach, driven by a drunken stage-driver). The result was 14 per cent. more days, almost, per person, among the intemperate.

Haskell.—There is one cause of consumption, which, I am confident, plays an important, though an insidious part, to which I have never seen any allusion made.* I have in mind at least four families, and more single persons, who were too proud to acknowledge, and too fastidious to endure, the sulphur purgatory, and who have harbored and nursed the itch until it became chronic, and either the irritation of the skin, or the roundabout methods they adopted to deaden it, have so broken the general health that they have rapidly gone into consumption. I have a strong impression that this odious evil is a frequent precursor of the more fatal malady. In the case of many a college student, whose untimely death has been lain at the door of *hard study* the *itch* has been robbed of its share of credit.

Collins.—I am a native of America; was graduated in medicine in '43; was connected with the public medical institutions of the city for ten years; served three years in the hospitals. In 1849 my health gave way, and consumption was developed. I left the city for the Island of Madeira, where I spent the winters of '49 and '51, four months, on the island. I then went to Spain, France, and England; was abroad one year. On my return I desired to find some dry, elevated region, where I could breathe better and cough less than in New York city. Having tried various parts of the United States, I finally selected the south-west corner of Massachusetts, eighty miles from Long Island Sound, 850 feet above tide-water, protected on the north and east by a beautiful mountain range. The Housatonic River flows rapidly through this portion of the valley. No swamps, nor low ground; an abundance of pure, soft water. Now this is the same relative protection that the city of Funchal (Madeira) has, and Malaga, Spain, and Nice, in the north-west part of Italy. The natives here (in Great Barrington) are healthy, and I very seldom meet with a case of consumption which originates in this region. I have been here twenty years, and have long since gotten rid of my pulmonary trouble.

The following letter, from Dr. Bartlett, suggests the importance of trying to get a radical change of climate or of telluric influences, by even a small change of location. Many dread the exile from home required by a Southern or Western resi-

* Unless the psora of Hahnemann be an exception, which he makes the cause of all diseases.

dence; many more are too poor to travel; but very many may be able to move the short distance from a wet place to a dry, warm slope. And Dr. Bartlett's letter suggests hope to such:—

CHELMSFORD, February 27, 1872.

DEAR SIR:—Knowing your interest in the influence of locality upon tubercular disease of the lungs, I have thought that it might not be uninteresting to you to receive the history of a case which I have been watching for some years, in reference to this point. A young lady of this town, whose mother died of rapid tubercular disease of the lungs (said to be congenital), and whose father died from pulmonary abscess, resulting from pneumonia, the recurrence of the abscess being frequent for seventeen years, manifested in a marked manner. All those indications which we at times notice in the young female seemed to show that her life would early be brought to a close, as her mother's had been. So strong were these indications that I earnestly advised her step-mother not to sanction an early marriage; but love proved stronger than preaching, and she married and went to live upon the highlands, known here as Robin's Hill. The result has been that all the symptoms of phthisis have entirely disappeared, and it would be difficult to find a healthier woman than she is now, after having borne three robust children. In the course of my inquiries I have learned one fact which it might be desirable to know, viz.: that no case of consumption has ever occurred in any of the families living about this highland. I think that many families, living in dread of the ravages of that terrible destroyer, might here find robust health, instead of being driven away from home to Minnesota and other wild regions of the West. At any rate, I think the experiment might be worth trying, and with every prospect of success. I know that in many cases patients dread the going away from home and its comforts, and if we have at our doors places where health and home may both be secured, at a cheap rate, many a life may be saved without the necessity of an expensive and tedious journey.

Yours, with respect,
JOHN C. BARTLETT.

I submit, almost entire, the following, from one of the oldest and most respected physicians of Maine:—

TOPSHAM, ME., November 19, 1871.

DOCTOR BOWDITCH: *Dear Sir*,—Since receiving circular of July I have reflected much upon the queries and suggestions therein proposed, but am fearful of my ability to impart any decided benefit to the cause you are engaged in, by any practical responses from my own experience. I have resided between fifty-one and fifty-two years in this town. In that time I have witnessed almost every form of consumption, and almost everything else which usually falls to the lot of a medical man. Beside my home practice I had a tolerably wide circle of consultations in Lincoln, Cumberland, and several other counties upon the eastern shore, and the regions watered by the Androscoggin and Kennebec Rivers. I feel strongly impressed with the belief that consumption, typhus and typhoid fevers are, in proportion to our population, much diminished from what they were half a century ago; so, too, are colic and cholera morbus. So far as my experience and personal observa-

tion go, consumption is far more frequent among the females than the males. The cause of this, no doubt, is to be looked for in the different habits of the sexes, chiefly in regard to out-of-door life, and also to the stronger sympathetic and emotional character of women, especially young women. I have been looking over my notes and diaries for a long time back, and I find the general tenor of my belief to be, in relation to the causes of consumption and its remedies, all in one direction. As Dr. Bowditch suggests a wish to receive "bits of family and personal history," I will, as briefly as possible, give that of the P. family, of this town, a name well known in the Atlantic States, North and South, and in Western and Northern Europe, wherever a cotton-ship was able to discharge her freight. It will epitomize a large class of cases of consumption. About one hundred and twenty years ago a young married man moved into town, and there were born to him, I think, five sons and three daughters; the sons were R., A., T., J. and D. The sons all lived and died in town, and in the immediate vicinity of where they were born: one of the sisters also; the two others lived and died in the adjacent town of Bowdoinham. I am not positively cognizant of the mortuary record of the families of the two sisters who lived out of town, but I am of the opinion that two or three cases of consumption occurred among them.

The following table, drawn up from the verbal statements of the writer of the letter, presents a more distinct view of the hereditary character of the process of consumption in this family than can easily be obtained from the letter itself:—

Original Stock.	Children.	Grandchildren, habits, conditions, &c.	Great Grandchildren.	Great Great Grandchildren.
This family moved into the town 120 years ago and had five sons and three daughters.	Robert died upwards of 80, of old age. .	Son, died of consumption. Son. Son. Daughter (Mrs. Hunter), died of consumption, . Daughter. Daughter.	Twelve children, 5 died infants, 7 adults. One daughter far advanced in consumption, married cousin, both husband and wife died of it, . . .	Daughter consumption. Daughter consumption.
	Acton, died, not consumption, . .	Several children, *none consumptive.*		
	Thomas, no consumptive signs, died at 80, of cancer; wife died of consumption, .	Son, cough, hæmoptysis, &c., but lived to 82, active; his wife grew stronger child-bearing, . . . Son, 82, alive and well. Son, asthmatic all his life, alive at 71. Daughter, single, died of *consumption.* Daughter, married, died of *consumption.* Daughter, married, died of *consumption.* Daughter, single, died of *consumption.*	All his children alive and well.	
	Joseph, drowned, .	Son, } twins { *consumption.* Daughter, } twins { *consumption.*		
	David, died, consumption, ...	Daughter, *consumption,* . . . . Daughter, typhoid fever. Daughter, puerperal fever. Son, consumption, married cousin. Son, sea-captain, alive, age 65.	One man child alive and well, age 50.	
	Daughter, ... Daughter, . . . Daughter, . . .	About the precise history of two, not much known, but *thinks one* or *two* cases of consumption among them. No consumption reported in the third.		

"The summing up of the teachings of these three generations of the P. family is as follows: First. The first question that naturally presents itself, is, Does this family history furnish evidence of hereditary predisposition to consumption? I would answer, Yes. Perhaps some would cavil at this, and ask, Why has not the family of A. P., with a larger family of sons and daughters, contributed to this consumptive catalogue, as well as those of his brothers, Robert Joseph, Joseph Thomas and David? It is not necessary, I take it, that every individual or every family should have such an obituary to establish the generally received truth of what is here affirmed. It has been my lot to have resided more than half a century in a community, where, eighty-five years ago, a family lived, and intermarried with cousins, in which insanity had shown itself. Among their descendants we find many families totally exempt from this terrible inheritance; while every now and then a case crops out in a branch which for generations, had not produced a person who has had insanity. I do not, of course, deny that other elements enter into the problem, and which have had a vast controlling power in bringing on or working out consumption,—moral causes, for instance; particularly, depressing influences. In T. P.'s family, the mother lived to see her sons come to manhood's estate: of the four daughters, all of them were in early womanhood at the decease of the mother,—the oldest was about twenty-four, the second, twenty-two, the third, eighteen, and the youngest, fifteen. The mother was a strong-minded woman, and in raising up and training her family, had the larger share of parental influence. Her death was, of course, a heavy blow. The boys, however, were just going out into the world, and mingling energetically in its busy scene; and by this means were somewhat removed from that extreme poignancy of grief at her death. Far different was the case of the daughters,—trained up as they had been, and learned to look and lean affectionately upon their mother for counsel, for sympathy and support, they felt her death as an irreparable loss, and so it was in truth; and not unlikely from that day they began to droop. The old homestead, to be sure, was still the seat of a generous hospitality; but to these gentle spirits, *their world* was the old hearthstone and the family circle; but what were these without their mother? And their brothers, also, gravitating, from other attractions, into different spheres.

These girls, when I first knew them in 1820, were neither sickly nor scrofulous,—they were smart, energetic, and, to all appearance, healthy. The eldest possessing the good housekeeping capabilities of the mother, took her place in the family. The second daughter was the most fragile of the sisters; tall and graceful, her features were somewhat pallid perhaps. The third daughter (she who died first) was accounted the most intellectual. Four months before her death she was, to all appearance, healthy; her facial expression was good. The roses and the lilies showed a fair admixture; and her activity and muscular movements betrayed no ominous indication of disease. The first and second daughters, Dr. N. Smith visited with me, several times; this third daughter, I believe I mentioned, became brain-affected, I presume from tubercular deposit. The youngest girl, had it not been for the sad death of her sisters, would, I think, have been the most brilliant.

Second. As to the therapeutical department, if I may say a few words. It would seem as if the most exhaustive efforts have been made to discover the means, as far as the Materia Medica is concerned, to combat consumption and to cure it. The four quarters of the globe, and every island, ocean and sea (save the yet unrevealed open Polar sea) have been ransacked for material aid. But for long, physicians have been much inclined to abandon

drugging. The Homœopaths still professedly have faith in copious dilutions; the Hydropaths in cold water: then there are the Mesmeric doctors, the vegetable Eclectics and the Electric experts in a medical way; all of these have pushed their claims for success, but the more intelligent the masses of our people become, the less will their faith be in these interested claimants for public notoriety. But aside from such as rest their claims for skill, upon a collegiate diploma, there is a vast horde of disreputable men who have entrenched themselves around the Patent Office, and who are constantly sounding their trumpets in the columns of every newspaper. There are very many thoughtful men, *outside, and in* the profession, who strongly believe that the way out of this labyrinth of professional mysticism and superstition will yet be pointed out by some philosophical and practical medical man. Perhaps the time is far distant when the correct pathology of what we call consumption, will be determined and accepted. But may not the laws of the imaginary Hygeia become so truly and faithfully established as to demonstrate the sources of danger, and thus enable one, who devoutly looks to his pathways in life before he leaps, to escape the danger of destruction? Some, perhaps many, of our recognized diseases may disappear; and new ones takes their places, perhaps, so that (if I may use the terse and sententious language of Bunyan) while "one escapes to die, another is taken to live."

Very respectfully,

Your humble servant,

JAMES MCKEAN.

The following facts and opinions are contained in a letter from Dr. C. G. Rothe, of Altenburg, in Saxony, Germany:—

Of twenty-seven cases of pulmonary consumption which came under my care during the last two years, there were

Caused or promoted by	hereditary influences,	4 cases.
" " " "	trades (1 miller and 4 cigar-makers),	5 "
" " " "	exposure to cold and damp weather, and by damp and cold dwellings in tenement-houses, void of sun and air; and in shops,	18 "

The latter 23 cases being of the age from 21 to 46 years, all of healthy origin and of good health up to the time of the onset of the disease. All of them were taken suddenly by a severe, obstinate catarrh, complicated with fever, want of appetite and emaciation, while the physical signs showed chronic inflammation of the surrounding portions of the lungs, mostly in the upper parts, but in some cases in the lower lobes, while the tops remained intact. This inflammation used to spread more or less rapidly over the whole side of the infected lungs, sometimes over both, and ending, in all cases but four, in the "caseous degeneration" of the parenchyma of the lungs and death after three to six months. In four cases the progress of the disease has been checked to the present day, through the inhalation of carbolic acid with tincture of iodine; in three of them all the physical signs have gradually disappeared, and their health seems to be totally restored; the fourth, a married woman, 32 years old, being constantly exposed to damp and cold in a

hat-maker's shop, had two relapses, and is now, two years after the first severe attack, lying down hopelessly. The inhalations of the carbolic acid had no beneficial effect on the hereditary cases of *tuberculous* consumption; and in those cases of inflammatory origin, where miliary tubercles set in, in the course of the disease, and where the disease spread below the insertion of the bronchial tubes, internal remedies such as cod-liver oil, hypophosphates, all proved of no avail. Drunkenness, sexual indulgence, and overstudy have not been noted amongst the causes of the disease. In children the disease has not been observed, except in one girl three years of age, who, two months after a severe attack of diphtheria, of which she was cured by the carbolic-acid treatment, died after nine days' illness with all the signs of acute tuberculosis. I have excluded this case from the above table because the denial of the post-mortem examination left the diagnosis uncertain. Among the four cases of hereditary tuberculosis there is one of a pregnant woman, in whom, during the stage of pregnancy, the disease developed itself with great rapidity, progressing, at the same time, in the lungs and larynx, so that she was for six weeks totally aphonic. She died three days after her delivery. I am of the opinion that much can be done towards the prevention of this fearful disease by close attention to every "slight catarrh," at its first onset.

C. G. ROTHE.

ALTENBURG, October 31, 1871.

THE ADULTERATIONS

AND

IMPURITIES OF FOOD.

By H. B. HILL,

Assistant in Chemistry, Harvard College.

THE ADULTERATIONS AND IMPURITIES OF FOOD.

Confectionery.

There seems to be a popular opinion prevailing that the only injurious substance which confectionery is likely to contain is *terra alba*, or sulphate of lime. From the present investigation, however, it would appear that the adulteration with *terra alba* is of little importance when compared with the common use of poisonous coloring agents. While 94 per cent. of the articles examined were found free from *terra alba*, 46 per cent. of the specimens of colored confectionery contained active mineral poisons.

The colors most frequently seen in the shops are the various shades of red and yellow,—less frequently the blues and greens, and among these the reds and browns are the only ones that are likely to prove harmless. In the yellows and greens poisonous metallic compounds are the most convenient and permanent coloring agents, and are therefore most commonly used.

No simple and ready test offers itself for the detection of injurious substances in confectionery, although for many articles a little boiling-water gives all the information that can be desired. The metallic coloring agents are insoluble, and those that dissolve are as a rule harmless. In all cases, therefore, where confectionery should contain nothing but sugar, this test can be applied with tolerable certainty, but it naturally loses its certainty when applied to confectionery that may properly contain, besides the sugar, insoluble organic matter.

The different samples of confectionery, all purchased in Boston or its immediate vicinity, were examined for mineral

adulterations, and the nature of the coloring-matter present was determined. They were also tested for starch, although no attempt was made to determine what form of starch had been added.

Seventy-seven samples of confectionery, both white and colored, were examined, and of these thirty-eight were found to contain starch. In most cases it was present in but small amount, but fourteen specimens contained large quantities.

In five samples *terra alba* or sulphate of lime was found. Three contained very little, and two a very large amount. In one of the latter specimens—a little sugar-toy—the ash, on ignition and subsequent treatment with sulphuric acid, amounted to 58.19 per cent. of the original weight, while good white sugar seldom leaves more than 0.1 per cent. of ash.

Of the seventy-seven samples examined sixty-seven were colored, and among them were twenty-one specimens of yellow, twelve of orange, twenty-nine of red, five of brown, seven of green and four of blue.

Of the twenty-one yellows, seventeen consisted entirely of chrome yellow or chromate of lead, two contained chromate of lead, although a vegetable yellow was also present, and two were colored with organic yellows alone.

Of the twelve specimens of orange, nine were colored with orange chrome or orange chromate of lead, two contained an organic red mixed with chrome yellow, and in one the coloring-matter was entirely organic.

Of the twenty-nine reds, twenty-five were organic, three samples of a brick-red color contained iron, and one was colored with vermilion or sulphide of mercury.

Of the five browns, four owed their color entirely or in part to the presence of iron.

Of the four specimens of blue, two contained only organic coloring-matter, and two were found to be colored with ultramarine, or silicate of soda and alumina with sulphide of sodium.

Of the seven greens, one, a pale green, was found to be organic, six were colored with a mixture of Prussian blue or ferro-cyanide of iron with chrome yellow, and one contained in addition arsenic green or arsenite of copper.

It will thus be seen that thirty-six of the seventy-eight pigments analyzed contained lead, one contained mercury, and one arsenic and copper.

The worst of the specimens analyzed will serve as an example of the poisons which may readily be brought together in the same article. It consisted of several mounted soldiers, gayly uniformed. The ground-work was pure sugar with no *terra alba* or starch. The red caps and the red trimmings of the soldiers' uniforms were vermilion. The yellow of their buttons and certain other parts of their uniform was chrome yellow, their blue coats ultra-marine, their cream-colored horses contained chromate of lead, and the grass over which they rode was Prussian blue mixed with chrome yellow, made brilliant with occasional patches of arsenic green.

As the confectionery generally took its color entirely from the poisonous metallic compound, and the quantity would therefore hardly fail to be injurious, it was thought advisable to make a more extended qualitative examination, instead of making a limited number of quantitative determinations. In one sample of yellow lozenges, however, which was, perhaps, a fair specimen of the more brilliantly colored yellow confectionery, the amount of lead was determined by my friend, Mr. Charles E. Munroe, assistant in the Laboratory at Cambridge. According to his determination the lozenges contained 0.13 per cent. of metallic lead. At this rate, ten of them would contain one grain of plumbic chromate, or fifteen one grain of lead.

A sample of a green coloring-matter used in tinting ice-cream, kindly sent me by Dr. H. K. Oliver, was also examined. By far the greater part of it was clay—silica, alumina, and a little iron being shown by analysis.

The coloring-matter itself was organic, and gave the re-actions of the aniline forms. The coloring-matter was slightly soluble in water, soluble in alcohol. The color was discharged by ammonia, and turned yellow by hydrochloric acid; moreover, ammonia was evolved on heating with soda-lime. No trace of arsenic could be detected. Whether the aniline colors may safely be used for coloring articles of food, even if they are free from arsenic, is a question that is open to doubt.

Pickles.

In addition to the adulterations to be found in vinegar, pickles are liable to be more or less contaminated with copper, which has either been added directly, or which comes from the copper utensils.

It is a matter of little difficulty to recognize the presence of copper in pickles. A fresh bright green color is usually a sufficient indication. Although copper is generally present in so small quantities that it can impart no color of its own, it appears to fix the natural green of the fruit, and prevents it from turning yellow or brown. The presence of copper may readily be confirmed by immersing in the vinegar poured off from the pickles, a bit of polished steel, as a knitting-needle, and allowing it to stand for several hours. All the copper, which may be present, will then be found as a metallic coating upon the steel, or if the quantity of copper be very small, the steel will have a reddish tinge.

Twelve samples of pickles, put up by as many wholesale dealers, were examined, ten of which were found to contain copper, and in these the amounts of copper were determined. From one to two hundred grammes of the pickles, with a fair proportion of vinegar, were incinerated, the ash was treated with nitro-sulphuric acid, and the copper precipitated by the battery and weighed as metal.

Nine of the samples were examined for alumina, and found to contain it, showing that alum had been used in preparing the pickles. The presence of sulphuric acid in the vinegar, therefore, gave no ground for supposing that sulphate of copper had been added.

The results of the analyses are given below. In the first column of the table will be found the description of the pickles as given on the label, in the second the weight of metallic copper in 1,000 parts, and in the third, for convenience of comparison, the number of grains of crystallized sulphate of copper in the pound to which the percentage of copper corresponds.

	Weight copper in 1,000.	Grains sulphate of copper to pound.
1 Gherkins,	–	–
2 "	–	–
3 Mixed pickles,	0.009	0.26
4 Superior pickles,	0.025	0.71
5 Chow-chow,	0.025	0.71
6 Extra pickles,	0.027	0.77
7 "	0.028	0.80
8 "	0.032	0.91
9 Gherkins,	0.035	0 99
10 "	0.039	1.11
11 "	0.052	1.48
12 Superior pickles,	0.077	2.19

The fourth, fifth and eighth samples were through inadvertence not tested for alumina—the rest were found to contain it.

Nos. 1, 2 and 5 were English pickles. The others were American.

THE HOMES OF THE POOR IN OUR CITIES.

By FRANK W. DRAPER, M. D.

THE HOMES OF THE POOR IN OUR CITIES.

The following Report embraces the results of a personal inspection of the house-accommodation and general sanitary condition of the poorer classes in eight of the large cities of Massachusetts. The writer desires, at the outset, to acknowledge the uniform courtesy with which indispensable official aid has been extended to him in the various cities during the prosecution of this inquiry.

Boston.

The inefficient policy which, for years, has been pursued by the city administrations in sanitary matters, and which has held sway in spite of the remonstrances of those who believed they saw the tendencies and fruits of such a course of indifference, has been demonstrated in no more tangible way than in the past and present condition of a large number of the dwellings of the poor. These homes of the laboring-classes in Boston, overcrowded, unfavorably located, unwholesome in their surroundings, constructed with little regard to health, have not been a credit to the city. It is not from lack of information on the part of the authorities that such has been the case, for these abodes of misery have been again and again described in official reports* and in less formal but no less impressive works† which have told the story of these habitations and of the legitimate influence on the health, the morals and the political purity of the community in which their continued existence is permitted.

The writer cannot add a single word or contribute a single fact to make the story, so often told, more graphic or more

* See, for example, previous Reports of this Board and the Reports of the Chief of the Bureau of Statistics of Labor in Massachusetts.

† Like Rev. E. E. Hale's sketch, "How they live in Boston and how they die there."

truthful. The characters of the squalid, unhealthy residences of the laboring and other poor in Boston have been so well delineated, that the public may be said to be now fully possessed of a true notion of their badness. Except to point out some of the features which distinguish the tenement-houses of this, the largest city in the State, and give them peculiarities demanding certain special methods of relief, this Report will not attempt a renewed presentation of the matter in detail.

The following localities and tenement-houses have been recently visited, and their condition was found to be unequivocally bad. Many of them are included in the list of places inspected by the Secretary of the Board in November and December, 1870, and found by him to be disgracefully unfit for human habitation.* A few of the localities mentioned in that connection have become changed, but the general condition of the tenement-houses of Boston is the same to-day as it was then, and presents the same attendant moral and sanitary abuses. The few changes that have been made are due, not to any sanitary zeal or prevision on the part of the city authorities, or to the active execution of any legislative measures, but to the natural encroachments of business, trespassing none too soon on quarters which should have long ago been demolished as dangerous nuisances. Thus, the infamous locality in Cross Street, known as "Stone's Yard," formerly the nest of squalor, disease and crime, has given place to a substantial structure for manufacturing purposes. But these exceptions are few in number and scarcely worth noting. The following list illustrates that the house-accommodation of the poor in Boston is miserably defective. The instances cited do not include all the bad dwellings, probably do not comprise all the worst ones, but they comprehend enough to show that something ought to be done speedily for their general reform.

105 and 107 Cross Street.
Young's Court.
Mechanic Court.
Blind Alley, rear 209 North Street.
Land's Court, 223 North Street.
Rear of 324 North Street.
Cook's Place, rear 390 Commercial Street.
Commercial Court, rear 476 Commercial Street.

* Second Annual Report of the State Board of Health, 1871, page 60.

Pond-street Place.
Institute Avenue.
54 Cross Street.
Keefe's Alley, rear 170 North Street.
Barber's Alley.
Alley from 362 North Street.
Cole's Block, rear 490 Commercial Street.
Utica Street.
Cove Place.
Shaving Street.
Rear 145 Kneeland Street.
Parts of Cove Street.
Rear of 298 Kneeland Street.
137 Beach Street.
Rear of 315 Federal Street.
Rear of 477 Harrison Avenue.
Sand's Yard, 483 Harrison Avenue.
Alleys from Jackson Avenue.
Holden Place.
Stanhope Place.
Wilberforce Place.
Smith Place.
62 and 72 Joy Street.
Rear of 69 Phillips Street.
Rear of 42 and 44 Phillips Street.
57 and 59 Barton Street.
Billerica Street.
Parts of Nashua Street.
28, 30 and 34 Lancaster Street.
126 Merrimac Street.
Alley from 132 Merrimac Street.
South Margin Street, Nos. 10 to 22.
Rear of 67 Pitts Street.
Rear of 71 and 75 Pitts Street.
Alden Court.
47 and 53 Portland Street.
Second Street, near Athens.
Granite Street.
Rear 118 Dorchester Avenue.
Silver-street Place.
Athens Street, near Second.
9 Silver Street.
Silver Street, between B and C.
61 and 63 Gold Street.
Rear of 13 Swan Street.
27 and 29 Swan Street.
Rear of 583 Shawmut Avenue.
Rear of 634 Shawmut Avenue.
Basement and Privies at 634 Shawmut Avenue.
844–46 Albany Street.
Belmont Street.
Rear of 24 Pleasant Street.
Foot of East Lenox Street.
Baldwin Street.
Primus Avenue.
Johnson's Block, Meander Street.

Among the indirect causes of the present overcrowding of the tenement-buildings of Boston may be mentioned territorial improvements which have recently been made. The raising of the Suffolk-street district and the improvement of the Fort-hill section displaced a great number of tenants of the poorer class, without the substitution of any provision for their housing elsewhere, so that existing tenements in other parts of the city are filled to repletion. The reclaimed sections will never again become the sites of dwelling-houses of such a class as were removed; but, while these parts will not revert to their former condition of reproach, other parts have become increasingly objectionable, as a consequence.

The proceeding of the Lowell Railroad Company in taking, by special Act of the legislature, a large territory in Nashua Street, for the purpose of constructing a new passenger-station, has been followed by results similar to those just alluded to. The section embraced many tenement-houses,

occupied by the families of Irish laborers. In the carrying forward of the improvement these houses were all demolished, and their occupants were compelled to seek other homes. Thus the neighboring streets have received considerable accessions to their already surfeited condition, and great overcrowding is the result.

Other elements besides those mentioned have been continually at work to keep the demand for tenements a pressing one. Boston is an important port of entry for the immigrants who are constantly coming to America, in the hope of improving their condition. Many of these people are of the poorest sort, socially, mentally and morally. They at once settle toward the bottom of our civilization and become its dregs. They find homes where they can, and congeniality of surroundings attracts them to the cellars and the crowded rookeries, not alone as a temporary expedient until they can afford better things, but because also they have just left homes in nowise superior to these. In the courts and alleys of the North End five thousand Portuguese are thus collected. Italians, too, are there in large force. While the number of Irish who, recently arrived in America, have drifted spontaneously into these insalubrious quarters is not easily computed. It is the misfortune, not the fault, of these people that they can do no better; it is the fault as well as the misfortune of a city like Boston that it suffers such a condition to continue, in spite of laws and ordinances to the contrary.

It is not necessary to detail the faults of construction which are everywhere conspicuous in the tenement-houses of the metropolis. They are familiar to everybody who knows anything of the manner in which the poor live,—whether we take the small and dilapidated wooden shell at the North End, the dingy relic of a past, when its low-ceiled rooms sheltered a more aristocratic connection, or the more pretentious modern tenement-house, containing within its thin brick walls a perfect colony of people, the deplorable absence of provisions for healthful comfort is general. Ventilation and sunlight are not salable commodities, and have a very inferior place in the reckoning of the man of business, whose speculation looks to the largest possible returns from the smallest possible outlay. He recks little of transom-windows, ventilating-shafts, cubic

allowance of atmosphere, open ground-space in front and rear, and readily takes advantage of any indifference on the part of the authorities to evade the carefully-drawn ordinances which would compel a different course. If his building is barely safe, and the inspector says it will not tumble down about the occupants' heads, there is slight inclination to do more with a view to prolonging the lives of the tenants. Thus old buildings continue, with their dark bedrooms, their wet and mouldy cellars, their insufficient water-service, their lack of ventilation, and new buildings emulate their elders in faulty sanitary construction.*

If we were to indicate one feature of the tenement-house evils more conspicuous for its offensiveness than another, we should name the privies before all others. These essential appurtenances are almost uniformly the prolific source of nuisance. Especially is this the case if, as generally happens, there is community in their use. Under such conditions they are unexceptionally filthy. Where a single privy is made to serve the needs of a number of families, none of which are particularly nice in such matters, there is very apt to develop about such a place an exceedingly objectionable state of things, which it is difficult to correct. The doors are left swinging, or perhaps there is no door at all; and, there being no responsibility as to cleanliness, there is abundance of uncleanness. The number of such indecent abominations about this city, loading the air with vile excrementitious odors, and contaminating whole neighborhoods, is very great; they constitute one of the chief evils with which the health authorities have to contend.

The remedy for this appears to be a simple one. Just as far as is possible let single tenements have their respective, individual privies, under lock and key as closely as the rooms of the house. There will then be responsibility, and the blame of delinquency can then be readily attached where it belongs. It is hardly possible that all tenements can have properly trapped water-closets, although such would be the best arrangement; but it is practicable that all privies shall connect with sewers, and, such being the law, the connection

* See Second Report of State Board of Health, 1871, p. 61. See also communication to "Boston Daily Globe," Oct. 25, 1872, for illustrations.

ought to be compelled as fast and as far as may be. To fulfil the double purpose of providing a privy which shall not be open to community of use, and which at the same time shall be the least liable to evils that, under the best regulations, cannot fail to excite inconvenience and complaint, the form of apparatus recommended by the board of health of New York city seems the best. It is that of the trough-privy, constructed best of brick and cement, with the necessary inclination toward one end, at the outlet of which a substantial iron grating is placed to prevent any obstructions from passing into the sewer. At the upper end, the proper flushing arrangement is adjusted, and the rain-water from the roof and the sink-drainings from the house could be made available for this purpose in addition to the aqueduct-service. Such a privy has been in use for some time in connection with a large tenement-house of this city, and it is satisfactory after prolonged trial. It is easily managed, and not liable to get out of repair.

Waiving many other themes in connection with the tenement-houses of Boston, it remains to be said that there is the promise of a better future with regard to their sanitary regulation. Very recently (December, 1872), the legislative department of the municipal government has felt compelled to obey the unequivocal and almost unanimous popular demand for a reform in the sanitary administration of the city and has ordained an independent board of health. This is not the place to enter into any criticism of this new plan, but we cannot help regretting that the departments of street, alley and passage-way cleaning, and of the removal of house-offal, and refuse materials have not been put in their immediate charge. It is to be remarked, in view of the responsible task to be undertaken by the board in Boston, that its appointment is not premature. It is a step in the right direction, which may well be followed by every city in Massachusetts.

Fall River.

The many mills of this prosperous city have attracted to it a great number of people, whose livelihood depends, directly or indirectly, on the activity of the manufacturing industries.

Thousands of Irish and of French Canadians are to be found here, constituting a considerable proportion of the population. They are not all self-maintaining; it is inevitable that with such a population there should be mingled a class of the very poor, the idle and the shiftless.

It is evident, on the most cursory inspection of the tenement-houses in which these people live, that the confessed need of suitable house-accommodation in Fall River is not overstated. The city is overcrowded; there are more people than can be healthfully housed within its limits. The numerous influx of mill-operatives within the last few years has answered the demand of the corporations for more labor, but the mills have not supplied the needed dwellings.

The legitimate consequence of this overcrowding is that rents are high, and those who must work hard to make their financial ends meet at all, must resort to various devices to help their insufficient incomes. Many tenants take boarders, filling their attics and spare bedrooms as uncomfortably full as possible. Many others follow another plan; it was not an uncommon thing, in the course of the inspection of the poor quarters, to find a family renting a tenement of three small rooms for ten dollars a month, and sub-letting, for seven or eight dollars, one of the two bedrooms to another family, equally large, who provide their own furniture (scanty enough at that), but who are permitted to cook their food on the stove of the petty landlord and to eat their meals at his table. Thus, the original lessee reduces his rent to a very moderate figure, and cares little how many laws of health he may set at defiance in his efforts to get on comfortably and with the least wear of mind and body.

While this unfortunate condition of overcrowding, due undoubtedly to the improvidence of some of the mills, forces the lowest class into the meanest abodes and entails numerous abuses thereby, the accusation cannot be brought against all the corporations. There are many whose tenement-buildings will compare favorably with those of any manufacturing city, and it is noteworthy that new mills (as, for example, the Flint Mills) are careful to provide for their employés suitable dwellings whose construction is admirable.

Another fact, in which the mill-corporations are concerned

as affecting the sanitary welfare of the laboring-people in their homes, is the practice of advancing money to builders and small capitalists, who complete the buildings and refund the advance by partial or entire lease of the premises for the use of the operatives of the mill. This leads inevitably to overcrowding and to abuses which must attend such ambiguous and irresponsible lesseeship; there comes greater or less indifference to the wants of the tenants and to the proper care of the buildings and premises.

In the course of the inspection of the tenement-houses in this city, many instances were found which violated the plainest sanitary laws and called for speedy interference. It is not deemed necessary to describe in detail all the localities visited, but attention must be called to some of the more significant cases.

In Ford Street, was a wooden building called "Covell's Block," which was leased by the Crescent Mills and occupied by the operatives of that corporation. It contained eighteen tenements of three rooms each. The tenants were French Canadian and Irish, and each nationality was very ready to charge the other with causing the abominations which were only too obvious to sight and smell. The tenements were overcrowded; in one was found a family of twelve, five of the children of which slept in one of the bedrooms. There was no water-supply on the premises; the tenants were obliged to resort to a pump in the yard of a neighbor. The sink-drainings were thrown on the ground beneath the windows. The privies were nasty beyond description.

At No. 11 Sixth-and-a-half Street, was a wooden tenement-house. In one tenement of four rooms, fifteen persons found a home. In each of two attics, with sloping ceiling under the roof, the extreme height being seven feet, six adults slept, a single window, tightly closed during sleeping-hours, keeping out the air.

Adjacent was a tenement of three rooms in which ten people kept house. The rent of this tenement was ten dollars a month; but the tenant, by letting one room with certain stove and table privileges, reduced the rent of the two remaining rooms to three dollars, at the expense of domestic comfort and possibly of domestic harmony.

At the corner of Eighth and Bedford Streets, "Harrington's Block" was visited. The windows of the bedrooms of half the house were closely against the dead wall of the house next adjacent, and there was no chance for light or air. The sink-drain emptied its contents on the ground directly under these windows and the stench therefrom was represented to be intolerable, sometimes compelling the closure of the windows. The cesspool, into which the drain should have led, was full. The vaults in the yard adjoining were full and their contents had overflowed the wall and poured out on the ground; the privy's condition was in full harmony.

Many of the families in this block took boarders, crowding the sleeping-rooms to their utmost capacity.

At No. 1 Thurston Avenue, a dilapidated wooden shell gave residence to four Irish families. The rent was collected by an agent who never heeded complaints. The sinks were thoroughly unserviceable, the walls were broken, and the whole building was unfit for human habitation. The rooms were all too full; one bedroom had six occupants. In the yard there was various and plentiful filth.

"Lord's Block," at the corner of Wade and Second Streets, demanded attention for its filthy privies and its overcrowding.

At No. 89 Spring Street was found a basement tenement of two rooms, containing a family of five. The single bedroom for this family was without window or other provision for the admission of light and air, except the open door.

At No. 66, in the same street, another cellar was visited; it was occupied by a family of four. The front room or kitchen of the tenement measured 12 by 14 feet, and the two bedrooms, 6 by 8 feet, the height being seven feet. Each of the bedrooms obtained outside light and air through a dirty sash, twenty-four inches square. In rainy weather, the water entered the rooms through the wall of the house. The yard of this house was extremely filthy; a stream of night-soil from the overflowing vault joined a stream of sink-slops from the house and combined to make the premises indecent and dangerous.

The mother of this family stated that she suffered habitually from ill-health during last winter, while living in this tenement.

The region called "Barberry Hill," between Anawan and Washington Streets, was found so totally bad that it would seem invidious to select any particular part of it to specify as worse than the rest. It comprises many tenements, all of them overcrowded, and all of them so surcharged, without and within, with filth of all sorts, that it passes understanding how the numerous colony here established survives at all. Stables add to the unsavory aggregation of dirt, and a general air of decay and of miserable and nauseating filth is apparent on all sides.

An old wooden building, called "Smith's Block," situated on Anawan Street, at the foot of Pocasset Street, and at the outer limits of the section just alluded to, was a type of the worst of the tenement-houses; it was crowded, the rents were exorbitant, there was want of repairs, and there was dirt, squalor and misery. Windowless bedrooms, broken ceilings, dark and dangerous stairways, leaking roofs,—these were the features of this unwholesome building. Two families, containing nine persons, occupied one of these tenements on the coöperative plan, the original tenant paying ten dollars a month and surrendering one of his rooms for eight dollars.

At No. 48 Washington Street, a house consisting mainly of the cabin of some dismantled schooner and adapted to its present purpose by an improved roof and an outside stairway, gave a very satisfactory income to the enterprising landlord, and furnished homes to four families, at a rate varying from $6 to $15, according to the number of rooms. The smallest rent was derived from two little rooms under the roof, occupied by a recently married couple who were economizing and who really deserved better things. Their living-room was eight feet square and six and a half feet high. Their bed was made up each night on the floor of this room. The yard of this house contained all varieties of filth.

Lawrence.

This city is fortunate in the possession of unusual natural advantages of situation and soil, to promote the sanitary well-being of its inhabitants. The sandy foundation on which its buildings stand, does not hold the surface-drainage, to stagnate and slowly evaporate, and the cellars are dry. Its loca-

tion on a plateau of considerable height, gives it additional salubrity; while the swift-flowing Merrimac, and the two tributaries which join that stream within the city limits, afford abundant and most efficient provision for deeper drainage and for sewerage.

Undoubtedly these natural advantages have served greatly to give Lawrence its high place in the list of the healthy cities; its mortality ratio in 1870 being 1.72, in contrast with 2.43 for Boston.

It is greatly to the credit of Lawrence that not many tenement-houses exist within its limits open to censure on sanitary grounds. The worst features as regards filth, improvidence and overcrowding, were not observed by the writer at the time of his inspection, and in proportion to the population there were fewer of the abuses and evils pertaining to the dwellings of the poor, than in most other places visited.

But it could hardly be thought that Lawrence would be immaculate in these matters, with its large population of foreigners attracted here by its well-known manufacturing industries. Here, as elsewhere, grasping landlords exist who do not scruple to let uninhabitable premises, and who care little about the welfare or comfort of their tenants, provided the rent is paid. Here, also, are some tenants whose inherent tendencies appear to be toward the filthy and careless ways which beget nuisances in spite of any landlord's caution to the contrary. It is fortunate that certain conditions, whatever they may be, whether general prosperity, or municipal supervision, or the influence of example, keep within comparatively satisfactory limits the evils to which the poor in the large cities are subjected.

At 24 and 26 Common Street, three tenement-houses, two in front and one in the rear, were found in a very objectionable state. The largest of the three contained nine tenements of two rooms each. Its rear wall was close against the rear wall of the building next adjoining, so that the bedroom windows were practically useless. Its attic, under the pitch roof, was occupied by five people in two rooms. At the end of the house farthest from the street, were the well and the privy-vaults, the well being nearest the house and situated so as to receive the percolating fluids from the vaults and from

the sink-drains. The yard adjacent presented abundant evidence of the careless habits of the inmates.

Between the ends of the other two houses alluded to, was the privy for the tenants of those crowded quarters. It was located close to the windows on either side, with a view to economy of space, and with little attention to other important interests. Its interior was an abomination.

At No. 92 Lawrence Street, was a wooden block of eight tenements, called "Dolan's Block." It was greatly out of repair in all its interior, from cellar to attic. A basement tenement in this shell was let to an ancient Irish dame, who shared her quarters with her son-in-law and her adult grandson. Two rooms accommodated these three persons.

At No. 372 Common Street, a family of seven, including five adults, occupied two bedrooms, paying $7 a month for rent.

Undoubtedly the feature of the poorer tenement-houses of Lawrence most open to censure, was the apparently unquestioned liberty which was allowed in the occupancy of untenantable basements. There were many of these cellar dwellings observed in the course of the inspection, and, as compared with other abuses, they were out of proportion.

At No. 118 Valley Street, a basement of three rooms, of about six-feet post, furnished a home to a family of six persons. The bedrooms each had a small sash which was the only window. It was enigmatical how any air, fresh or otherwise, could find its way through this aperture. The rent of this cellar was $8 a month.

At No. 126 in the same street, a family of eight lived in a basement of three bedrooms and a kitchen, two-thirds under ground. Two of the sleeping-rooms shared, for their air and daylight, a sash of three panes of glass, an ordinary cellar-window; the third had a sash, two feet square, for itself exclusively. The rooms were seven feet high. There was no sink; the slops were thrown into the street.

At No. 136, a family of eight people occupied a cellar tenement almost identical in description with the last; and at No. 148, was a cellar seven feet high and seven-eighths under ground, with six occupants, who paid $10 rent. One of the two bedrooms had a three-pane cellar-window; the other had a more liberal allowance—nine panes.

At No. 36 Common Street, an Irish laborer, his wife and his three children lived in a cellar fourteen feet square and two-thirds under the ground. They cooked, ate and slept in a single room, and the whole five occupied the one small bed at night. There was no sink in the room. Two small windows were the only provision for ventilation and for the admission of daylight. Altogether the premises presented a most suggestive picture of misery. It was to the credit of the occupants that this single room, which was their home, was neat, and that poverty was not found incompatible with decency. The curse was that a man could be found grasping enough to let such a tenement, and that a city administration could be indulgent enough to permit such an act.

Although it is scarcely relevant to the subject, the writer cannot avoid alluding in terms of admiration to the tenement-houses owned by the great mill-corporations of Lawrence, and leased by them to their operatives, as an example of the fruits of an intelligent and liberal purpose to provide homes for the working-people which should merit the name; these extensive blocks of neat brick houses can challenge competition with any similar dwellings anywhere. The plan of their construction, the yard-room, the system of sewerage by means of a canal diverted from the river to run beneath all the tenements and take away at once all the sewage, the provision for the systematic removal of swill, ashes and refuse,—all these afford an example of what judicious and humane corporations, who have in view the sanitary welfare of their operatives, can do. Such results are of exceeding value for the sake of emulation, and even as a matter of policy, as promoting the productive energies in the tenants; by preserving their health and so economizing their vigor, they justify a thousand-fold the expense of their elaboration.

Lowell.

The health authorities of this city have been stimulated within the past two years to unwonted efforts to improve the sanitary condition of the whole community. An epidemic of small-pox, severe and long-continued, turned general attention in 1870 to matters of public health; and a systematic

inspection of the city and a wholesome execution of the health ordinances was the result. The people were compelled, for once, to keep their premises more clean. Under the impulse afforded by the presence of a general epidemic, a salutary reform in all matters pertaining to the public hygiene of the city was effected.

This worthy work, although in a considerable degree intermitted since the time alluded to, has not altogether lost its influence, after two years. It is to be regretted that the commendable zeal manifested at that time of revival should not be of continued vigor; it had its immediate reward in a manifest improvement in the condition of the poorer classes and in the mortality rates for the years in the interval.

In common with all the rest, the homes of the poor experienced the beneficial effect of this vigilance in sanitary matters, and the evidence is absolute that the abodes of poverty in Lowell, the premises around which more than any others the squalor, the filth and the misery of overcrowding lurked, are to-day comparatively free from the extreme abuses which prevail in some other localities in Massachusetts.

The dwellings of the mill-operatives, of whom there are so many in Lowell, are to be excepted from any unfavorable comment; for the manufacturing corporations exercise a most efficient supervision over the tenement-houses of their employés.

But the vigor which characterized the administration of the health affairs of Lowell two years ago will shortly forfeit its fruits unless it be renewed. The tenements of the poor, although in most respects relatively free from abuses, are beginning to show the inevitable tendency to relapse toward their former state. In three localities which the writer visited, there were present conditions requiring the attention of the sanitary board for their immediate or prospective reform.

In Middle Street were seen a series of wooden tenement-blocks of one story each. The tenements consisted of two and three small rooms, and they were all too full. Many of them were unfit for human habitation, from lack of proper conveniences or from want of general repairs. Two of the

blocks had basement dwellings almost entirely below the level of the street, and approached by a steep and broken stairway leading down to the damp area in front of the doors. These cellars were occupied by Irish tenants, who urged their poverty in extenuation of their occupancy of an underground dwelling.

The surroundings of these tenements were less objectionable than one might expect to find them. There was the usual privy adjacent, its vault full and very foul; but the yards were comparatively clean with regard to rubbish and swill. The alley at the rear of the houses was too low, too wet and too filthy to be conducive to health.

In William Street, some of the houses had very unwholesome back-yards, with puddles of stagnant water; ashes and rubbish had accumulated and the privies needed attention.

One or two blocks in Gorham Street, near Middlesex Street, were open to a like criticism.

In Winter Street were found several tenement-houses occupied by Irish people; these dwellings testified to the need of incessant watchfulness on the part of the health guardians in order to keep them habitable. Their sink-drains, privies and back-yards were by no means above reproach.

It is a gratification to report concerning Lowell that, with a few exceptions like those noted, the condition of the working-people was found to be comparatively satisfactory in their house-accommodation and general sanitary care. It demonstrates the benefit of efficient, energetic sanitary supervision, and it should stimulate the efforts to make the condition of the city much better than it has yet been. The ravages of the small-pox epidemic in all classes, deplorable as they were, can hardly be thought altogether ill and pestilential in view of their indirect consequences on the health of the city.

Lynn.

Of the thirty thousand people comprising the population of Lynn, the greater portion are provided with occupation, and derive their sustenance from the shoe-manufacturing interest, for which the town is well known. This industry, in connection with the branches of mechanical work allied to it, is

attracting continually a class of thrifty laborers who steadily promote the growth of the population and add to the wealth of the community. The effect of this on the general appearance of the town is manifest, not only in the large and substantial buildings, the manufactories and warehouses, which occupy the streets in the central sections of the city, but in the great number of neat and comfortable, although small dwellings, the homes of the working-class. The impulse of vigorous municipal life is felt also in the suburbs, and scores of dwelling-houses are being built, of neat architectural design and surrounded by a liberal area of ground. These are rapidly taken as homesteads. It is impossible not to draw the inference that there is some intimate relation between this wise policy of separate homes as thus illustrated and the condition of public health which makes Lynn rank high among the cities of Massachusetts in point of salubrity. The plan of congregating many families in tenement-houses finds little favor here, and an impression of prosperity and of healthy development obtrudes itself almost everywhere.

Such is the inference from a general survey of this busy city; but Lynn tolerates within her borders certain "homes" which a detailed inspection can discover and which are very little in harmony with sanitary law and are very discreditable to the health authorities. The instances given below will show how some of the poorest class in this city are provided with house-accommodation.

In a street called South Street, leading from one of the principal thoroughfares of the city and surrounded by residences whose appearance indicated that they were owned and occupied by intelligent and prosperous people, the writer visited a hamlet of three wooden buildings. The largest of these was once a sash and blind factory, and the name of the manufacturer, who is still the owner of the buildings since their change into wretched tenement-houses, appears in bold letters on the side of this main structure. By means of variously contrived partitions, this factory afforded tenements for four families. These families consisted, at the time of the visit, of nineteen negroes, and three whites; the latter, natives of Ireland. The two families on the ground-floor did not suffer for want of light, for the windows of their room were

abundant; but those who occupied the attic beneath the steeply-pitched roof did not fare so well. The approach to these upper tenements was by a broken, dangerous stairway on the outside. The door from these stairs opened upon a narrow passage-way which served as a pantry, kitchen, wash-room and workshed, all in one, and containing a miscellaneous collection of fuel, dirt, food, cooking-utensils and rags, accordingly.

Out of this narrow apartment, a door opened into a larger room, whose ceiling was the sloping roof; the walls were bare and stained with smoke and the tracks of rain; the floor was bare and rough. A small skylight admitted scanty sunshine and shared with the door the privilege of indifferent ventilation to the inmates. The black girl, who was keeping these apartments during the temporary absence of the family, asserted that in rainy weather the roof admitted water in uncomfortable quantity.

Two sleeping-rooms, within this room just mentioned, completed the suite; one was entirely without windows, and got light and air through the door alone; the other had a sash in the roof. Both contained piles of ragged and dirty bedding, thrown promiscuously on the floor, attesting the abject poverty and squalor of the inmates.

The foregoing description is not an unfair detail of the manner in which all the families lived, in the three houses. There were, altogether, thirteen families comprising fifty people. A year ago small-pox found a lodgment here, and took special advantage of the situation to go through the crowded hamlet.

The location of the building was high and dry, and eligible for good drainage; yet an unmistakable stench pervaded the premises. The cause of this pervasive odor was readily found; for these thirteen families, two privies with open vaults were provided, and they were within a dozen yards of the better houses adjacent. The vaults were full and one was overflowing; a stream of night-soil bubbled up from beneath the side of the privy and trickled away toward the house, mingling in its course with sink-drainings which had been thrown on the ground by the tenants. The floors and seats of the privy were foul beyond description.

The air which comes to this elevated spot in a state of comparative freshness and purity goes away burdened with foulness. The wonder is that such a place, with its squalor and its offensiveness, is permitted to continue at all, and especially that it is tolerated in such a neighborhood, where it must be a perpetual nuisance.

Barker Court, another illustration of sanitary improvidence, is at the lowest part of a basin whose deficient drainage compels the stagnation of water almost the year round, and in summer is said to promote the development of an odor which is almost intolerable. There are quite a number of single tenements here, and two or three houses containing several families. The adjacent territory, which is higher and which contains many excellent residences, shares with this depressed area the ill-effects of its low location. The writer was informed by Dr. Pinkham, the city physician of Lynn, that in this region typhoid fever, diarrhœa and dysentery, bronchitis and diphtheria specially manifest themselves. The ground in the street and in the yards was covered with a green fungus mould. The ground beneath all the houses on one side of the court was covered with stagnant water, and the tenants said that these pools had remained in their present condition as to depth throughout the summer

In this court, and immediately adjacent to dwelling-houses, was a stable, with a pig-sty attached in which two large hogs were fattening. A pile of stable-manure embellished the yard. Close to the stable and piggery was the privy, its vault full and open, and its internal appearance extremely foul. These stable premises were the object of grievous complaint among the tenants.

The whole section should be raised and thoroughly drained, and the attendant nuisances should be speedily abated.

The tenement-house called "Buffum's Block" illustrated some of the worst evils of the crowding system. Here was a building eighty feet long, thirty feet wide, and containing a basement, two stories and an attic; the upright rooms were about ten feet in height. At the time of the inspection, nine families, containing forty-six persons, had their homes here. In the basement, below the level of the street, were three families. The inmates of the block were Irish.

A row of sheds in the rear contained the fuel and the privies of the tenants; the privies were very foul, and justified the comment of one of the people, that "no decent woman would go near them." Much complaint was made, also, of a privy on adjoining premises; the vault of this privy was not tight, and as it was on higher ground its contents percolated through the soil and entered the yard of Buffum's Block.

"Perley's Block" on Boston Street, an old wooden shell, with leaking roof, broken chimneys, falling ceiling and general decay, furnished tenements to eight Irish families, containing forty-five persons. The lower story was on one side below the street-level, the grading of the street having covered so much of the block on that side. On the other side of the house was a marsh through which flowed a brook, and this marsh was sometimes under water close up to the doors of the building. Two privies, too dilapidated for use and too filthy to mention, were supposed to fulfil the needs of the tenants.

It was encouraging to observe in this ancient rookery, one poor woman endeavoring to improve her chance for long life, and to give a little cheer and sweetness to her home, by lime-washing the walls and ceilings of her rooms. She was a practical sanitarian.

In one of the basement rooms a woman and her daughter sat by a tub containing green goat-skins. These the two sewed together in pairs, so as to form bags in which the tanning-liquor was held during a part of the process of the manufacture of the skins into morocco. The moist and dirty pelts looked foul, and made the premises and the dress of the women to correspond. For this work they were rewarded with a scanty pittance, which went only a little way toward paying the rent of their miserable abode. In summer, so they remarked, the stench from the skins was "pretty bad" when the warm weather made them "putrid."

Salem.

This city can present, in its house-accommodation for the poorest classes, specimens of the best and of the worst tenement-houses. Of the former, those blocks of dwellings owned and carefully superintended by the corporation of the

Naumkeag Cotton Mills are illustrations. These buildings are constructed with due regard to their use as dwellings, and they are very satisfactory as regards light, roominess and internal arrangement. Their yards, privies and water-service are well attended to, not only by the tenants themselves, but by the company's agents, who are careful to compel general cleanliness. In consequence of the regulations for promoting these systematic measures, an aspect of tidiness and thrift is everywhere apparent about these homes of the operatives.

The situation of these corporation tenements is advantageous, with an abundance of sunlight and of air fresh from the harbor. In some instances, ground that was once unsuitable for building purposes has been reclaimed by filling and by judicious drainage. Ample allowance has been made, in partitioning the tenements, to provide space enough, and to prevent overcrowding among the tenants.

The occupants of these dwellings are, of course, by preference, the families of operatives in the mills, and it is presumed that a certain degree of pride on their part, the legitimate offspring of their improved estate, seconds the efforts of their employers to provide clean, comfortable and roomy homes for them. It is impossible not to note, however, the evidences, even in these carefully superintended tenements, of national characteristics, strongly marked, and, as it would seem, indelible. Some nationalities are, by inherent tendency, careless, improvident and untidy, and it will require generations of training and of promotion in civilization before they can lead, and not follow, in sanitary education. If any comparison can properly be made, the French Canadian residents of the section of Salem above described deserve a word of commendation for their neatness and order.

But one has not to go far from these homes of the operatives in the mills to find homes of a very different sort. Upon the same insulated point of outlying territory on which the Naumkeag Mills and their tenements are built, a region of made land, bounded by Naumkeag Street on the west, and by the harbor on the east and south, are a number of streets containing many scattered tenement-houses. The whole section

is low, and, although the slope of the land is toward the cove of salt water which ebbs and flows with the tide, it is not effectually drained at the surface, and no sewers or deep drains have been laid by the city. In many parts, the ground is submerged under stagnant pools containing all manner of decaying organic matter, and covered with a green scum, the sign of decomposing filth, which, in the warm season, must be intolerably offensive.

It is needless to describe in detail the various dwellings in this district. Scarcely one of them was free from faults in construction or in situation, which would condemn them as nuisances, in greater or in less degree, in the judgment of vigilant health authorities. Plenty of air there certainly was, fresh from the sweeping harbor, but the atmosphere which these people ordinarily inhaled around their homes was surcharged with noxious smells and miasms from the stagnant pools.

To find an illustration of this condition, let the Salem health authorities inspect the house numbered 18 Congress Street. At the time of the writer's visit, this house stood in the midst of a pond of stagnant water. In the same watery lot was an overflowing privy-vault, and a piggery added its contributions to the general filth. Two families, containing altogether sixteen persons, occupied the house, apparently undisturbed by conditions sufficient to poison the air of all the neighborhood.

Other tenements in the vicinity corresponded in character with the one described. At No. 26, in the same street, a single privy was made to serve eight families; its condition may be imagined. The yard was under water, and ashes and rubbish abounded. Goats, ducks and poultry shared the occupancy of the house with the human inmates.

At No. 35 in Congress Street, and along South Prospect Street and East Gardner Street, a similar condition of things called emphatically for radical relief.

The tenement-house on Ward Street, known as the "Old Rubber Factory," has been graphically described in the Report of the Chief of the Bureau of Labor Statistics for 1872. It was found by the writer to be in no degree better than is there reported. Eighteen small tenements, consist-

ing of two and three rooms, poorly lighted and with bare walls, are in this dilapidated wooden barrack, but at the time of the inspection, twelve families, averaging each five persons, were tenants. Most of these tenants were widows. The care of the building and the collection of the rent were delegated to one of the Irishmen, who had long lived on the premises. The building, which is three stories in front and two in the rear, is built into a bank, so that the basement, opening anteriorly on the street, is at the back entirely underground. One of these basements was occupied.

A single well supplied all the families through an old-fashioned wooden pump. This well, being at a low part of the yard, necessarily took the surface-drainage of the adjacent ground, and as the yard was strewn with garbage, refuse and sink-slops, the quality of this superficial water-shed can be conceived. The five privies which accommodated (?) the occupants of the eighteen tenements were in execrable condition; their doors were broken down, and their interior was a mass of filth. The tenants "did not remember" when these vaults had been emptied. A pig-pen was closely adjacent to the privies. Three cesspools, with their connecting-pipes much out of repair, received a part of the sink-slops; the rest was thrown on the ground.

Opposite this factory-building, on an alley running through to Peabody Street, was a tenement-house, which was formerly a barn. It supplied homes to five families. The first floor was a foot below the surface of the ground. In a tenement of two rooms, the larger of which was thirteen feet by eight feet on the floor and seven feet high, a widow and her two children lived, paying rent at the rate of $54 annually. She said it was sometimes very cold there, for the water came in under her floor.

Adjoining this, on Peabody Street, was a tenement-house of a similar character. Eight families lived here, much too closely quartered. The small back-yard was rendered almost intolerable by an open cesspool and a privy in very foul condition.

No walk in Salem can be taken, more suggestive in its associations than that along Derby Street. This thoroughfare along the water-side, at the head of the numerous

wharves, was once the busiest street of all the town. In Salem's prosperous mercantile days, this long avenue was crowded with all the evidences of successful traffic. On one side, large warehouses received the stores from beyond the seas as they were landed from the great ships; while, on the other, the Salem merchants lived in the enjoyment of their accumulated wealth.

But the days of the rich India trade have passed for Salem; commercial enterprise has yielded to other interests, and the wharves and warehouses are no longer the scene of vigorous mercantile life. The mansions have surrendered their rich and aristocratic inmates; with the retirement of the commercial enterprise, a new class has taken possession. What was formerly the richest quarter is now almost the poorest and most depraved. The great houses are partitioned to make tenements. Even the wharves, now no longer serviceable for the moorage of ships, are delivered over to become the homes for scores of laborers' families. In this once proud thoroughfare, poverty seeks its dwelling-place, and vice, dirt and ignorance, its attendants, prevail.

The majority of the dwellings in this strangely changed quarter are better than the class of people who occupy them usually select. The old mansions are so situated that overcrowding of the land-area with houses is impossible, so long as these substantial structures shall stand. The interiors of the dwellings are, however, in many cases so changed for adaptation to the demands of the present tenantry, that the allowance of room is at the minimum.

The worst house found during the inspection of this section was that numbered 22 on Tucker's wharf. It was filthy within and without. A pig-sty was at the door. The slops were thrown on the ground about the door, and all sorts of refuse littered the yard. In a single room under the roof, scarcely big enough to contain the two dingy beds, and lighted and ventilated by a small square sash at either end, the six inmates of the family slept in promiscuous informality.

On this wharf, at No. 15, two families occupied cellar-tenements, each having two rooms.

At No. 9, a dirty back-yard, overflowing privy-vault, and redolent pig-sty, gave evidence of inexcusable neglect.

At Gerrish Place was found an emphatic illustration of neglect on the part of the landlord. A two-story wooden tenement-house, intended for twelve families, but occupied at the time of the visit by eight, was shamefully out of repair. Its windows were broken, its roof leaked, its cellar was dirty and wet, its privies (two for the house) were full and filthy, its cesspools were filled with ashes or overflowing with dirty water, its yard was neglected, and the whole aspect of the premises was that of decay and misery.

Moreover, there was the most reckless improvidence on the part of the owner or owners; none of the tenants ever saw the landlord or his agent, or knew who he was. At long intervals somebody came, when things became especially bad and the premises were complained of as a nuisance, but any manifestation of interest in the welfare of the tenants was almost wholly wanting; it appeared to be of little consequence to the proprietor whether these people paid their rent regularly or not at all, whether their comfort and health were at hazard because of the need of repairs, whether, even, old tenants moved away and new ones moved in without notice. Families have been known to occupy rooms for quite an extended term without the knowledge of the owner or of his agent, and, accordingly, rent free. At the time of the visit of the writer the premises were an unequivocal nuisance.

Springfield.

The poorest class in the people of Springfield, comprising the families of railroad laborers and the like, do not constitute a numerous company, and their habitations are relatively few. In comparison with many cities of larger size, the number of families in which squalor, misery, filth and such accompaniments of poverty abound, is quite limited. These people live in isolated and well-defined sections,—in portions of the city where the homes of the better class are not found. Miserable enough some of these dwellings were seen to be, exemplifying the worst sanitary evils which can pertain to human habitations.

The greatest number of these abodes were found on a narrow belt of land along the crest of the river's bank, at the lower part of the city. This strip of territory is separated

from the rest of the city by the tracks of the New Haven Railroad, and is scarcely broad enough for the single series of tenement-houses, which are close to the edge of the steep bank of the river.

The worst of these buildings is that known as "Trask's Block," a brick structure designed for twenty-four tenements, of three rooms each. The rear of the building is close on the line of the railroad, and the front faces on the river's bank. On the steep slope in front was a plentiful display of all the garbage and refuse which the families had accumulated there since the last rise of the river had washed away the previous gathering of a similar nature. The house was greatly out of repair,—its windows broken, its stairs dangerous, its roof leaking. The privy arrangements were peculiar. At each end of the porch or piazza on which the front doors opened was a rough out-building. The two out-houses were designed to accommodate all the tenants, a design plainly evident to any one approaching the house. The vaults were brick receptacles, entirely above ground, the steepness of the slope beneath the porch giving room for this method of building. One of the vaults had broken outward and the abundant contents had settled away, a filthy mass of excrement gradually approaching the river's edge. Most of the tenants declined the use of these privies for obvious reasons, and resorted to expedients which can only be hinted at.

For water, these people were obliged to go to a spring at some distance from the house, the well originally provided being no longer available. When, however, the river rose above the level of the spring, a not infrequent occurrence, they took the water needed for cooking and drinking from the river itself, not far from the point at which one of the main sewers emptied into the stream. During the writer's visit to the premises, one of the tenants, a barefooted, uncomely Irish woman, took from her room a pail filled with chamber-filth, and having emptied it into the river near the spring, she rinsed the pail and filled it with water for her domestic use.

The condition of things above described fully justified the complaints and execrations of some of the tenants, who

represented that the filth and stench were almost intolerable during the summer months.

The adjoining premises, familiarly known as "Hole-in-the-Wall," were a trifle better as a human habitation, but by no means tolerable. The owner relies on the uncertain service of the stream below to wash away the accumulated night-soil from the privy-vaults, whenever a flood makes the depth sufficient; and to this end, the wall of the vault toward the river was left open.

The building called "Smith's Block" helps to maintain the bad reputation of the neighborhood with respect to nuisances. The yard was covered with swill, garbage and filth; while the privy conveniences were still more elementary and less tolerable than those before alluded to, consisting of the ordinary filthy, dilapidated out-houses over a perfectly open inclined plane of plank, freely exposed to view from the river. When the water rises, this planking is temporarily cleaned; at other times, surface-drainage, promoted by rainfalls, carries downward much of the loose excrement to the stream, where it mingles with the water, habitually used for washing the clothes of the people who live in the more aristocratic quarters.

Another of these river-bank houses was called the "Bee-Hive." It contained nine tenements, crowded like the neighboring houses, with Irish tenants. It had once been used as a store-house. Its basement was let to a family at the rate of eleven dollars a month. The yard was filthy with sink-drainage, swill and the like.

One noteworthy feature with regard to these tenement-houses was the manner and place of the discharge of one of the main sewers of the city into the river. The mouth of this sewer was immediately adjacent to this settlement, close down to the water's edge, indeed, but at most seasons of the year perfectly exposed. The arrangement for the discharge of the sewage was not apparent, whether a trap existed or not; but the writer was informed that a simple swinging door was the only apparatus at the mouth of the pipe. Those resident near by asserted that, in the hot season, the stench in that vicinity was very bad.

In Union and Wilcox Streets, at their lower extremities,

and so near the section just described as to be really a part of it, a number of insalubrious places occupied by poor Irish laborers were visited. "Haley's Block," at No. 35 Union Street, was one of these. The yard in the rear was excessively dirty and the open mouth of the well received plenty of surface-drainage to pollute its water. The basement of this house furnished a home to its owner; in two rooms, more than half underground, he and his wife and their six children had their abode. The front room was twelve feet square and seven feet high and the bedroom was twelve feet by eight. In the bedroom was a single window, two feet by four, to all appearance never opened. The rooms were both miserably filthy.

At No. 20 in the same street was a tenement-building for eight families. They had each two rooms A cow-stable with its pile of manure and a full privy-vault were in cl se proximity.

The section to the east of Main Street, comprising the western extremities of Liberty, Ferry, Sharon and Congress Streets, is filled with houses for the poorest class. It is a basin whose level is ten or twelve feet below the level of Main Street. Prudent foresight on the part of the city authorities would dictate the filling of this territory. As it is at present, it is inevitably deleterious in its influence on the health of those living there. At the time of the visit there was much stagnant water upon the surface, and in the absence of any proper drainage the whole section must be damp the year round.

The character of the people and of the homes in this section coincide with the ground on which they are; they are below the proper level. A large number of basement-tenements were observed. The yards were foul, the privy-vaults were neglected, and numerous stables added the unsavory contribution of their manure-heaps to the general dirt.

As regards the relative amount of sickness in the localities which have been described as compared with the up-town sections, the writer was assured by two physicians of excellent authority that disease was of greater frequency among these people, that two-thirds of the cholera infantum occurred in these tenement-houses, and that while the general average of

mortality from consumption in the city was less than formerly, in these districts it was greater.

WORCESTER.

The tenement-houses of this city are asserted, on competent authority, to be in better condition and more habitable than they have been in former years. It is said that partly in consequence of more zealous attention to their sanitary state on the part of the board of health, and partly, also, because of an improvement in the social condition of the laboring-classes, the house-accommodation of those classes is comparatively less objectionable on sanitary grounds. There is no doubt that the medical profession in Worcester appreciate the importance of proper sanitary administration as influencing the health of the whole people. The office of city physician has repeatedly been filled by men whose vigor and efficiency have had a marked effect in municipal health affairs.

While happy to make this favorable reservation with respect to the municipal supervision of the tenement-houses, the writer feels bound to report great room for farther improvement. The sanitary condition of the poor is still far from being as good as it might be, and there is a lack of many elements which might be applied to remove preventable sources of physical and moral deterioration in and around the dwellings of the poor. A walk through the quarters of these people reveals a sufficiently large field for hygienic zeal, as the following notes may indicate.

Between Mechanic Street and Front Street is a section, lying very near the Albany Railroad station, which is low and flat. The centre of the region is Spring Street; on either side of this narrow thoroughfare and in adjacent courts are a number of dwellings occupied by Irish. They are not especially uninviting in their external aspect, but a closer inspection of the premises discovers many nuisances. Immediately adjoining one tenement a trio of hogs fattened on the collection of swill and garbage of the neighborhood. Under another house was an extensive and quite deep puddle of water, the overflow of a broken aqueduct-faucet which, at one corner of the house, supplied all the families in the building. At No. 5 in the court leading from this street was an old house, in the

basement of which, two women, a widow and her aged mother, lived; the former paid the rent and other expenses of the pair by stitching shoes by hand. The entrance to the tenement was down a flight of broken wooden steps. The women said it was cold and uncomfortable, but they could not afford better things. Two rooms, both half underground, and dreary enough with their smoky ceilings, bare walls and small windows, were all the home these women had.

The yards of these buildings in Spring Street were dirty and offensive, with a plentiful litter of refuse, ashes and swill.

Another group of Irish tenements not far distant from the last, rivalled them in all bad qualities. They were on Mechanic Street, and were known as "Coffee's Buildings." The yards were exceedingly filthy; in addition to a plentiful dressing of garbage, the sinks contributed a fluid nuisance, discharging all their drainings directly on the ground from lead-pipes which protruded through the side of the building. The single privy which was for all the tenants was open and excessively filthy and offensive. Adjacent were other privies, entirely open, with seats and floor too foul to describe. Near at hand a piggery contained tenants congenial with the surroundings, but incompatible with the city ordinance.

The occupants of these wooden barracks were of the lowest laboring-class. Some of them were especially degraded in appearance and manner and scarcely understood English. One large family occupied a cellar tenement.

Perhaps the most emphatic illustration which Worcester could furnish of a bad tenement-house was found in a block of wooden houses on Shrewsbury Street. It was known as "Pond's Block." It was intended for nine families, not including a series of basements which were sometimes hired for liquor-saloons; only four families, however, found the place sufficiently attractive, at the time of the writer's visit, to pay the exorbitant rent demanded for such dwellings. Externally the house appeared deserted, if window-casings without sashes, and sashes without glass, and broken and unhung blinds, and general decay were significant. Yet the place was a home to human beings. In one tenement of four rooms were found an Irish family of eleven persons, a father and mother and nine children. The father pointed out some of

the pleasant features of his residence. There was no latch to the door, and at night he secured his rooms and obtained some degree of privacy by piling his furniture against the entrance. Scarcely a whole pane of glass kept the frosty air from the inmates. The man had rented with his tenement the basement beneath him, but he had, in great disgust, determined not to occupy this cellar as a bar-room, because of its filth. The floor of the cellar just behind the bar-room was a mass of reeking mud, and the sink-drain, which was suspended along the sleepers overhead, was broken and leaking. For these apartments the man was charged $22.50 a month.

In one of the basements of this block a family lived who had had their home in various parts of the building during the last four years. It consisted of two adults and a child. They had three small rooms, one of the two rooms in the rear being a bedroom and the other for storage. The former had no window. The sink was obstructed and the slops were thrown in front of the door. Sometimes the water came into the sleeping-room through the rear wall. For this tenement the rent was $10 a month.

Throughout the house there was dirt. No attempt was made to keep the vacant tenements secure by lock or bolt; the doors even were in many cases wanting. The water-pipes were out of repair and the sink-drains were full. The floors of several of the rooms had been used as privies by occupants of the house and by chance passers. The shanties originally intended for privies were too filthy to be entered and their vaults were overflowing.

Adjoining this building, was another tenement-house for six families, owned by the same man as the last. In most respects it rivalled its neighbor in filthiness. The privy of the house was within eight feet of the back-door, and its vault was full and uncovered. The yard was foul with swill. The tenants stated that the landlord was very regular in his demand for the rent, but scarcely ever heeded their complaints for repairs.

The section called "Pine Meadow" is the Five Points of Worcester. It is at the eastern part of the city, and consists of a hamlet of tenement-buildings, comprising, generally, old houses which have been removed here and altered, not to

become habitable dwellings, but to give the largest available rent. The houses are crowded, and the police know the region as the worst under their supervision. Drunkenness and crime make repeated calls on their services. Piggeries add to the general filth. A number of basements were found occupied as tenements by people two poor or too degraded to seek for better quarters. In some instances the most disgusting condition was found without and within the houses. In other instances scarcely any proper provision was made for the healthful comfort of the tenants. At No. 57 East Worcester Street, a cellar-tenement of three rooms, two-thirds underground, was let for $6 a month to a widow, who lived there with her three children. The mother supported herself and her family by the sale of beer. In this tenement there was no wet-sink, and the slops were thrown on the ground near the door. No water-service was supplied in the house, and the people were obliged to go to a distant well for water for their cooking and drinking purposes.

In the vicinity of "Pine Meadow" is a cemetery, and the moral character of the inhabitants of this section could be inferred from the repeated desecrations which the burying-ground had suffered,—its tombs broken open and its memorial-stones thrown down.

In the southern part of the city, is a section known by the euphonious title of "Scalping Town." Here one large tenement-house was seen situated on the very edge of an undrained marsh. It contained ten dwellings, each of four rooms. Two cellar-tenements were occupied. The storage-cellars were on the ground-floor in the rear of the basement-dwellings, and they were always wet and frequently flooded. It was not unusual to these tenants to see their front-yard under water and their fuel submerged. The worst feature of this building was its location; and it will continue to be objectionable until the marsh is systematically drained.

In the vicinity of this place were found other dwellings open to sanitary criticism. Such were tenements in Winter street Place, and in Salem Street, adjacent to the city stables; where the situation is too low for drainage into the common sewer, and the sink-slops flow on to the ground to make a stagnant, filthy pool near by.

Such are some of the facts pertaining to the house-accommodation of the poor, as they have been gathered in the course of a personal inspection in the large cities of Massachusetts. They are believed to possess a value as a contribution to the beneficent work whose aim is to elevate the sanitary and the social condition of the self-supporting poor, and so to promote the welfare of the whole people. They are a salutary exposure of some of the evils incident to the commonly prevailing improvident and unsanitary system of house-accommodation. They represent an amount of human misery and degradation not easily conceived. They suggest physical and moral decline, whose special characters no pen can adequately delineate. They recall fearful lessons which the past has failed to profit by, and they indicate no less fearful probabilities in the future, associated with the conditions in which the overcrowded, neglected, ignorant poor are permitted to continue. It is hoped that they will aid in confirming what has already been accomplished, in wisely amending the sanitary abuses which pertain to the dwellings of the working-classes in the large cities, and will stimulate to greater energy the work of hygienic reform.

That such conditions as have been described must exert a deleterious influence on the health of those subject to them would seem to be too obvious to require any discussion or formal demonstration. The whole weight of common sense and the whole sum of the experience of the past are in favor of the conclusion, that where filth, overcrowding, inattention to ventilation, bad drainage, the exclusion of sunlight most abound, there disease and death gather their victims most conspicuously. It is not meant by this, that these unsanitary conditions can originate disease, or can directly kill, but, by the slow deterioration of vitality which they favor, they are the strong ally, the active coefficient of human disorder and decay, compromising the power of endurance in those who are continually exposed to them, and too often opposing an effectual obstacle to restoration.*

* To fully demonstrate the relation between excessive disease, or mortality and excessive overcrowding and its attendant abuses, would require an aggregation of facts and figures, comprising a series of years and many places. For the present, with the existing methods of registration of mortality, and without any system for the

There will be many who, acknowledging the truth of all that may be asserted concerning the evils of the tenement-house system, will yet affect indifference with regard to possible reform in the matter. They will say that the endeavor to lift the ignorant and degraded class out of a condition to which they are so assimilated, and which they may be said to love, is too Utopian to be practically philanthropic. These specious opponents of any sanitary reform in this direction should be reminded that in no slight degree is the health of a whole city, the best social sections with the poorest, compromised and jeopardized in proportion to the degree to which conditions which appear to be irreparable and unpreventable are permitted to become developed. The rich suffer with the poor, because every crowded tenement-house, every neglected yard, cellar and privy contributes something to the general contamination, and the health of a whole neighborhood feels the deleterious effect of an ill-ordered alley or court filled to repletion with unwholesome inhabitants. For the sake of the physical integrity of the whole community there should be no indifference, and measures and methods for the correction of the evils in any city should command the coöperation and sympathy of all classes.

It is difficult, in commenting on the bad effect exerted on the public health by the habitations of the poor as at present generally ordered, to keep out of sight the close alliance which exists between physical want and misery and moral degradation. It is an association which constantly forces itself on the attention of any one at all conversant with these classes. Not only do almshouses and hospitals recruit their inmates from the quarters where the poor are huddled in unsanitary promiscuousness, but the jail also recognizes the well-defined districts whence its habitual convicts are taken. The moral as well as the physical condition of a population

registration of disease, absolute statistical testimony concerning this relation is necessarily out of reach. An important indication of the conclusions toward which such investigations would tend is afforded in the report of this Board for 1871, page 350, wherein is presented an analysis of the mortality of the city of Boston for 1870, based on sectional differences as regards conditions believed to influence the duration of life. The contrast there shown between the ratio of mortality in the better parts of the city, where good homes and favorable surroundings are the lot of intelligent inhabitants, and that in the worst sections, those most crowded, most filthy and most insalubrious, is suggestive, if not startling.

becomes inevitably assimilated to that of their habitations. Physical uncleanness and moral pollution are correlative, and it is impossible that persons accustomed by necessity or choice to live in a filthy community, to share promiscuously the domestic arrangements which decency is accustomed to surround with privacy, should not become demoralized. The very conditions which lower the tone, blunt the nerves and vitiate the energies physically, also exert a corresponding moral effect. The intelligent student of sanitary science cannot ignore, if he would, this element in the problem, and only feels the greater demand for better things.

In the presence of such conditions as we have thus touched upon, the problem of vital importance is concerning the remedy for their present amendment, and for the prevention of their recurrence in the future. Can old tenement-houses be made better than they are, and is there enough active interference in the way of sanitary supervision of the plans of those proposed in future? What is the prospect of amelioration?

And, first, Can much be expected from the tenants who occupy the houses? Granting all the deficiencies which belong to the house-accommodation of the poor, is there in these, the lowest classes, a manifestation of the inherent tendency of mankind to rise to better social and moral conditions, sufficient to warrant the belief that the spontaneous energies and ambition of these people will sometime create a demand for more habitable homes, and lead to the abandonment of such dwellings as are now too frequently provided? The foundation for such a faith is a narrow one, and is distantly prospective. These people are poor, and dependent for support on the unskilled labor of their hands. Their poverty and their dependence compel them to accept the condition of things that is offered them. They are not masters of their circumstances, and if, by exceptional energy, any of them grow out of their degeneracy and attain better fortune, their vacant places in the tenement-houses are quickly filled by those reduced through misfortune, while the emigrant-ships supply any deficit in the ranks of poverty, ignorance and degradation by recruits from the slums and huts of the Old World.

Poverty, forced to take up its abode in miserable habitations, quickly begets a loss of pride and self-respect, or confirms their hereditary absence in those who have never known them. It is probable that many of the tenants in the lowest courts and alleys do not secure as good homes for themselves as they might. It is lamentably notorious, indeed, in very many cases, that they prefer their present degradation to any change for the better, careless alike of the benefits to themselves and to their children from improved house-accommodation, and ignorant of the subtle influence of their present insalubrious surroundings to demoralize and destroy. Those who administer public charities,—the hospitals, the dispensaries, the aid-associations,—know well the character which is here represented, the abject loss of self-esteem and of self-dependence, which is indigenous in courts and narrow alleys. The reports of these institutions, defining the residence and the nationality of the ready recipients of charitable service, are very suggestive.

A distinguished English sanitarian * has lately asserted that "the cardinal basis of national health is a wise education." The aphorism is a true one; but if it be applied to the classes most in need of that education, it is too theoretical, for the process of their spontaneous emancipation from present subjection to unhealthful surroundings must be slow and uncertain. It is not well to trust too hopefully to such an agency as education to effect the sanitary regeneration of the poor. With the burden of habit heavily upon them, with so little intelligent ambition, with such hereditary contentment in insalubrious homes, external, peremptory and immediate forces must be brought to bear upon these classes to bring about their hygienic renovation.

If so little can be expected from the unaided efforts of the tenants toward attaining better homes, certainly not much can be hoped from the landlords, as a class. Shameful as it is that prosperous and reputable men can consent to hold the relation which many do toward their tenants, for the sake of selfish aggrandizement, there is very little encouragement that their selfishness will become revolutionized, so long as rentals

* Dr. Henry Acland.

show such cheering returns for capital invested. If Christian gentlemen in high station can reconcile it with their notions of uprightness, and with their conscientious convictions of honor, to own tenement-buildings like those described, whose construction and surroundings render them wholly unfit for human habitations,—dark, filthy, dilapidated rookeries, from which exorbitant and wholly disproportionate returns are received, is there not some pretence of excuse, or extenuation for the less favored landlord, whose training in business honor and in morality has been in less cultivated schools, if he make haste to be rich by emulating his superiors in taking advantage of the necessities of the poor? It is a mean and unworthy subterfuge which, in either case, shifts responsibility on wholly irresponsible agents, or on middle-men, who are willing, for the commission, to extort each month the hard-earned rent-money. The twenty-five per cent. of profit accrues to the landlord, and with such comfortable rates of interest, there is little chance that he will incline to help humanity by the practical application of any sanitary sentiment to the welfare or comfort of his tenantry.

Some most worthy exceptions must, however, be made in thus representing the character and relation of the tenement-house landlord. The owners of the dwellings of the poor are not all extortionate or improvident of their tenants' sanitary welfare. Many instances might be cited in which landlords see it to be their duty, as well as their interest, to make their tenants comfortable and to insist on cleanliness and decency.

But perhaps the most gratifying results have come from the alliance of capital with philanthropic purpose. Whether the experiment has been made by individual capitalists or through incorporated association, the fruits of the endeavor have been highly satisfactory. What has been done in this direction in England is well known. The beneficent schemes of Peabody and of Miss Burdett Coutts, and the operations of the Improved Industrial Dwellings Company in London, have demonstrated what may be accomplished in this direction.*

But we need not go far from home to discover an emphatic

* See the Second Report of the Massachusetts State Board of Health, pp. 193–218.

illustration of the good effects of an intelligent and philanthropic purpose to ameliorate the sanitary condition of the poor, by making their bad homes better and by providing new homes of the best. The structure in Lincoln Street, Boston, known till recently as the "Crystal Palace," and notorious in past years as the vilest example of a low tenement-house, has been regenerated through the systematic efforts of the Boston Coöperative Building Company, an association not yet three years old. So radical has been the change in this once infamous establishment, that the writer makes no apology for quoting the following account from the Report of the State Board of Health for 1872 :*—

"The most interesting and important act the corporation has performed was the hiring of the Crystal Palace. It was described, in last year's report, as the abode of filth, robbery, drunkenness and prostitution. * * * * Under the rule of the company the following most interesting results have been obtained: The building outside, instead of being a disgrace to the street by its filthy look, has a neat appearance. It has changed its name and now instead of the name of contempt, 'Crystal Palace,' it is styled the Lincoln Building.

"Before the corporation entered, riot, disorder and arrests for drunkenness and family broils, were of constant occurrence. The place was the objective towards which apparently all the scoundrels of the neighborhood congregated. * * * * All is now changed. The trade of the police is virtually gone. The chief of the district reports that during two months he heard of no complaints there. The grog-shop that had existed from the time of the erection of the building was swiftly swept away. A 'Holly-Tree Coffee House' has taken its place. The basement-tenements * * * were shut up immediately after the company took possession. Very large shafts have been cut through the roof of the building, through all the floors, with ventilators above them, and rooms that have never had light and air now have a sufficiency of both."

Such results as these show what is possible in sanitary reform, and the lesson is the more emphatic in view of the unpropitious subject of the experiment. The work of such an association is worthy of all emulation in radically amending what is unwholesome in the present habitations and in erecting new dwellings which shall serve as models. The writer is glad to report that the present condition of Lincoln Building, as observed on personal inspection, is a continued evidence of the philanthropy and wisdom of the reform un-

* Page 11.

dertaken by this company. Every city of considerable size, in this State and in every State, can provide ample opportunity for the beneficent operations of just such associated effort.

In this connection a word should be said concerning the scheme, advocated so cordially by Mr. Quincy and others, in favor of suburban homes for the working-classes, built and occupied on the coöperative plan, and, by means of cheap railroad transportation, before and after working-hours, made available to the laborer whose work is in the city. The proposition is, in theory, an eminently wise one, for it aims to enable the poor man to become his own landlord, to remove his family from an insalubrious city tenement to a country home; it purposes to relieve overcrowding and its attendant evils by substituting a condition far preferable. It offers a fair profit to the investment of the capitalist and at the same time gives the laborer a chance to become more self-reliant and more independent, as well as more healthy.

Already signs are manifested that the plan will ultimately find favor with the classes it is designed to help. As a practical method for the relief of the problems which have been discussed, it deserves the highest success.

One of the chief obstacles, however, to the present realization of such a scheme is the disinclination of the laborer,—of the very poor and unintelligent class,—to accept such an opportunity when it is offered. The principal causes which operate to fill and to keep full the city tenement-houses are their cheap rates of rent and their proximity to the work which falls to their occupants. The laboring-man of low degree, belonging to the class most needing emancipation from the detrimental influences of the tenement-house, will prefer to keep his inferior and unhealthy city quarters, which are small, cheap and near his work, rather than accept another chance with superior probabilities, on sanitary or social grounds. The average laborer must grow up tediously to an appreciation of what is possible to him in his home. For the present, he waives considerations of neatness, of convenience, or of comparative comfort, and takes the cellar or the attic, esteeming the immediate necessity as of greater consequence than any prospective advantage.

Indirectly the coöperative plan will do these classes great good by vacating tenements now occupied by mechanics whose intelligence enables them to see the advantages of such a project, and who are not dependent on casual employment. A promotion in house-accommodation is thus opened to the class below them.

But the conditions to which the poorer classes are exposed in their habitations urgently need immediate amelioration. It is unwise to await the slow civilization of the degraded poor, or to expect much better things of landlords, or to depend on the results of limited philanthropic enterprise. The remedy should be prompt and, as far as may be, efficient. It lies chiefly in the power of the law and in its honest administration.

And surely the law-givers of Massachusetts have not been unmindful of their responsibility in this direction. Chapter 26 of the General Statutes shows that early in the history of the State the legislators appreciated the importance of broad and comprehensive measures for the protection of the public health throughout the Commonwealth. Some of the provisions of this Act are as follows :—

SECTION 1. A town respecting which no provision is made by special law for choosing a board of health may, at its annual meeting, or at a meeting legally warned for the purpose, choose a board of health, to consist of not less than three nor more than nine persons; or may choose a health officer. If no board or officer is chosen, the selectmen shall be the board of health.

SECT. 2. Except when different provision is made by law, the city council of a city may appoint a board of health; may constitute either branch of such council, or a joint or separate committee of their body, a board of health either for general or special purposes, and may prescribe the manner in which the powers and duties of the board shall be exercised and carried into effect. In default of the appointment of a board with full powers, the city council shall have the powers and perform the duties prescribed to boards of health in towns.

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SECT. 8. The board or health officer shall order the owner or occupant, at his own expense, to remove any nuisance, source of filth, or cause of sickness, found on private property, within twenty-four hours, or such other time as it deems reasonable after notice served as provided in the following section; and if the owner or occupant neglects so to do, he shall forfeit a sum not exceeding twenty dollars for every day during which he knowingly permits such nuisance or cause of sickness to remain after the time prescribed for the removal thereof.

* * * * * * *

SECT. 10. If the owner or occupant fails to comply with such order, the board may cause the nuisance, source of filth, or cause of sickness to be removed, and all expenses incurred thereby shall be paid by the owner, occupant or other person who caused or permitted the same, if he has had actual notice from the board of health of the existence thereof.

SECT. 11. The board, when satisfied upon due examination, that any cellar, room, tenement or building, in its town, occupied as a dwelling-place, has become by reason of the number of occupants, or want of cleanliness or other cause, unfit for such purpose and a cause of nuisance or sickness to the occupants or the public, may issue a notice in writing to such occupants or any of them, requiring the premises to be put into a proper condition as to cleanliness, or if they see fit, requiring the occupants to remove or quit the premises within such time as the board may deem reasonable. If the persons so notified or any of them neglect or refuse to comply with the terms of the notice, the board may cause the premises to be properly cleansed at the expense of the owners or may remove the occupants forcibly and close up the premises, and the same shall not be again occupied as a dwelling-place without permission in writing of the board.

Section 14 provides for the forcible entry of premises by the board of health, for the purpose of inspection, and grants the aid of sheriffs and other officers of the law in the execution of this power.

Such are some of the provisions of the general statute law which are available in the management of tenement-houses and which are of general application. Other supplementary enactments define certain features of this law more specifically.

Thus, Chapter 211 of the Acts of 1866 provides for appeal to the county commissioners in case the board of health in any city or town refuse or neglect to pass proper orders abating a nuisance or nuisances and these commissioners may have, in such case, all the powers of a board of health as designated in Chapter 26 of the General Statutes, above quoted.

Chapter 271, of the same year, provides that boards of health may appoint an agent or agents to act for them in cases of emergency; and the agent so appointed may exercise all the authority which the board appointing him had.

Chapter 160 of the Acts of 1868 extends the provisions of Chapter 26 of the General Statutes and enacts that "when any lands in any city or town are wet, spongy or rotten, or covered with stagnant water so as to be offensive to persons residing in the vicinity thereof, or injurious to health, the same shall be deemed a nuisance," to be abated by the board of health of the city or town containing it; and provides the

methods of proceeding, in the matter of giving hearings to parties aggrieved; of making such improvements in drainage and the like as shall be required to correct the nuisance; and of awarding the damages incurred.

But the law for "the preservation of the public health," which, in its general application was deemed comprehensive enough for the State at large, was not thought enough for Boston, a city of large population and of metropolitan character; so that in 1868, the general court enacted Chapter 281, the Tenement-House Act, whose sections provided a great number of specific regulations, defining and limiting the functions of the board of health concerning tenement and lodging houses upon an elaborate and diffuse scheme. This law was founded on one which appeared to have been found practicable and useful in New York, where an expert and disciplined corps of sanitary inspectors, composed of medical men, aided most essentially in securing the advantages and fruits belonging to sanitary legislation in the metropolis.

In 1871, the Tenement-House Act was repealed because it had not accomplished much, or for some other reason not quite clear; and in its stead, a law was made which, in sixty-three sections, covered all that the previous Act comprised and a great deal more beside, providing for "the regulation and inspection of buildings, the more effectual prevention of fire, and the better protection of life and property in the city of Boston." This law is numbered Chapter 280 of the Acts of 1871, and is known as the Building Law. Among its numerous sections, are included seventeen [34–50] which are devoted to the regulation of tenement-houses. These seventeen regulations, prohibitory and restrictive, are elaborately technical, but, if properly understood and honestly enforced, they might afford great relief in matters to which they refer. Their complication, however, with other things makes them involved and unsatisfactory; and the collision of authority resulting from the investment of the execution of the building law in two coördinate departments of the city government,—namely, the board of health and the department for the inspection of buildings,—greatly compromises any benefits which were intended. It is very difficult to determine just where the functions of one board begin and those

of the other end. Many matters which, according to Chapter 26 of the General Laws, are left to the discretion and in the control of sanitary boards, are here transferred to another and a new official, who by the latest enactment is deemed essential in Boston to supplement an unpractical board of health.

If, however, the inspector of buildings in Boston and the board of health find it possible to act harmoniously in the enforcement of this law, it is scarcely to be doubted that they will together find any lack of statute provisions in this complex instrument. Lest the plain and comprehensive instruction of section 11, chapter 26 should, from its general terms, induce some administrative indifference,* the authorities of Boston are favored with enactments for the care of its tenement-houses as follows:—

1. The construction and appurtenances of tenement-houses in Boston shall, "on the requisition of the board of health," conform to this Act, and the inspector of buildings shall see that the Act is carried out in accordance with such requisition, and shall approve all plans for new houses.

2. Exterior walls shall be of brick or stone.

3. Tenement-houses shall have their sleeping-rooms properly ventilated by transom windows, and their halls shall be ventilated by means of a proper ventilator in the roof.

4. A suitable fire-escape shall be provided.

5. Roofs to be kept water-tight, and the stairs and their railings safe.

6. The water-closets and privies shall be approved by the inspector of buildings; they may be used in common by the occupants of two or more houses, in the proportion of one to every twenty people; they shall connect with sewers where practicable, and in a manner acceptable to the building inspector. Avoidable cesspools are prohibited and back-yards must be drained.

7. Cellar-tenements may be occupied as dwellings with the permission of the board of health, and without such permission, provided certain conditions as regards height, underground proportions, drainage, ventilation, &c., are fulfilled.

8. Cellar sleeping-rooms must have the approval of the board of health or of the superintendent of health.

9. The removal of garbage and refuse matters must be provided for; and the keeping of detrimental articles and of animals is prohibited.

10. The owner or keeper of the house is held responsible for its cleanliness in all its parts, in a manner and to a degree satisfactory to the board of health. The name of the owner or agent must be legibly posted within the building.

11. Free access for inspection is given; and the presence of infectious and contagious diseases must be reported by the owner or keeper to the board of health who shall take action accordingly.

* See page 435, *ante*.

12. Houses unfit for habitation, through the presence of infectious disease or for the want of repair, may be closed by order of the board of health, and kept vacated at their discretion.

The remaining five sections refer to prospective buildings and regulate the ground area, the height of rooms, the number and size of windows, the means of ventilation for rooms and hall-ways, the construction of chimneys and the water-service. Finally, "the inspector of buildings, with the approval of the board of health, shall have authority to make other regulations as to cellars and as to ventilation, consistent with the foregoing, when he shall be satisfied that such regulations will secure equally well the health of the occupants"; the building inspector, in other words, being executive, and the board of health advisory in the important matters of ventilation and of cellar-dwellings.

The obvious objections to this last clause were appreciated by the legislature of 1872, who amended it by giving the authority to the board of health alone to "make other regulations as to cellars and the ventilation of tenement-houses."

One is certainly at a loss to discover the special need which Boston has for such an amount of legal verbiage and complex statute limitation to enable it to take proper sanitary care of the homes of its poor. It is difficult to understand why the general law for the preservation of the public health* is not broad enough and comprehensive enough to enable any discriminating and efficient board of health to do all that can possibly be attained by the provisions of such legislation as chapter 280, Acts of 1871. Surely the tenement-houses of Boston are not so much worse than those of Fall River or Salem or Springfield that a special law is needed here, nor is the preservation of the public health so much more important in Boston than elsewhere. If the board of health of Boston needs such a multiplicity of technical instructions, together with the equivocal support of a coördinate department to enable it to go right, surely the same need exists in other populous localities; while, on the other hand, if the general statute avails for conditions outside the limit of the capital, it ought to serve here. This general statute gives to boards of health

* Chapter 26, General Statutes.

the responsible position of active official guardians of the public health, their more or less expert discretion is made the safeguard of the community against the preventable sources of disease, including those which have been detailed in this Report. To them are granted extraordinary, in some senses arbitrary legal powers for the administration of their office. They scarcely need the additional aid or control of such enactments as the Boston Building Law. They certainly do not need the embarrassment of such a section as that which leaves the occupancy of cellar-dwellings provisional, when, by all sanitary and medical experience, such occupancy ought to be absolutely prohibited by law.

This glance into the statute-book of Massachusetts can hardly leave a suspicion that there is any lack of law for the sanitary regulation of the homes of the poor. It is, however, scarcely possible to judge correctly of the practical merits or demerits of these laws as they now stand, or to estimate the actual disadvantage attending their execution. It is deplorable that enactments capable of great good to the health of the whole people, if honestly executed, are, for want of honest execution, nearly dead letters in practice in almost all the large cities of Massachusetts. In a general way, they may be said to be in force as directing and developing municipal measures and ordinances for the preservation of outside cleanliness and decency, but a cordial, energetic adoption of them by any city can scarcely be asserted.

The cause of this indifference lies in part in the constitution of the boards of health in the various cities. Uniformly, health affairs are delegated in these cities to the mayor and aldermen,* an unwieldy body of politicians, elected annually, with no distinctive responsibility and with no intelligent experience in sanitary administration. In one or two instances cities have appointed a special health officer, but generally the duties of that position are imposed upon the city marshal or chief of police, whose tenure of office is not so assured as to make him independent in the performance of sanitary duties, and whose fitness as a police officer is by no means compatible with fitness as a sanitary officer.

* An exception must be made with regard to Boston, whose independent board of health has just been organized.

Left in such hands, measures of public health are very apt to have indifferent administration. The execution of the law requires special tact, involves special responsibility and is surrounded by special embarrassments. For these reasons, the interests of public health tend to take a secondary rank under existing methods of municipal administration; external improvements, the preservation of order, the control of public works and the disposal of public money are, at present, of more consequence in the eyes of the city council than any abstract considerations of hygiene.

The remedy for this appears to be in the clause of the law which provides for the appointment of independent boards of health in cities and towns; for the choice of a limited number of active, expert, intelligent men, endowed with all the duties, the powers and the responsibilities which the law now gives, and holding their office during good behavior. Under such an organization, what is now compelled to share official attention with many other matters would become the distinctive business of a compact body; official circumlocution and delay would be without excuse in such hands, and prompt, energetic, independent action would be the price of office-tenure.

But next to the importance of having such a board in the abstract is the obvious necessity of its proper constitution. The choice of its members should rest, not in political preferment, but on fitness for the place. If sanitary ordinances are worthy of being executed at all, they deserve the most intelligent as well as the most thorough execution. To this end, no board of health is properly constituted which has not secured in its membership the active service of medical experience. The professional training of the physician fits one better than that of any other avocation to appreciate the sanitary needs of a community, and his daily practice carries him into the midst of conditions from which arise the sanitary exigencies demanding the attention of a board of health. He, more than any one else, knows from his daily observation where the uninhabitable tenement-houses, the overcrowded alleys, the polluted courts, the filthy yards are located, and his expert education enables him best to designate the presence, the effects and the remedy of the sanitary abuses, in all directions, from which the people ignorantly

permit their vigor and their health to suffer. In all sanitary administration, medical science, whatever other elements are introduced, should have, if not a controlling, at least a coördinate influence. Every township in the Commonwealth may well and readily avail itself of the statute privilege to have such an official sanitary supervision of its affairs. Every city ought to feel it an imperative necessity to do so.

In conclusion, the writer believes that he has not unduly magnified the importance of his subject. In detailing the facts contained in this Report, he has desired to give them truthfully and without prejudice, and in the belief that they did not require the aid of sensational elaboration to render them emphatic; they are sufficiently emphatic in the plainest garb. That they do not represent the average condition of the homes of the laboring poor throughout the State is admitted, for if they did so, our civilization would be truly degraded; they do, however, illustrate a real and a preventable condition, inconsistent with health, and constituting one of the most important fields for the work of sanitary reform.

The lesson enforced by such an inspection as is here reported is that, if it is manifestly impossible that every poor man can have a perfectly healthy habitation, it should be made practically impossible that any poor man should live in a disgracefully unwholesome dwelling.

REPORT

OF THE

BUTCHERS' SLAUGHTERING AND MELTING ASSOCIATION.

REPORT.

To the Secretary of the State Board of Health.

DEAR SIR:—In compliance with your request for a statement of the operations of the Butchers' Slaughtering and Melting Association up to the present time, I have been desired by the directors to submit to you the following Report:

The work of securing the land approved by your Board has been completed, and the rendering-house, together with one block of buildings for slaughtering cattle, one block for slaughtering sheep, the necessary stables for horses, a barn and sheds for cattle, and an engine and boiler house, are nearly ready for occupation. We confidently expected that our works would be in operation by the first of the present month; but delays unavoidable, owing to the magnitude of the enterprise and the novelty of its plan, as well as to the fact that the land had to be excavated and graded before the foundations of the buildings could be laid, have obliged us to postpone the time of commencing business for a few weeks longer. That those who feel interested in the success of the scheme we are engaged in carrying out may understand how extensive is the task imposed upon us, I give the following statement of our investments thus far:—

We have paid already for land purchased or taken under our charter the sum of (in round numbers), ...	$44,854 00
For expenses upon real estate, including drain-pipes, grading, &c., ...	5,300 00
For a wharf, as authorized by the harbor commissioners, ...	5,000 00
Carried forward, ...	$55,154 00

Brought forward, ...	$55,154 00
The corporation owes for land purchased and yet not settled for, ...	50,000 00
And has offered in settlement of land damages for land and buildings taken under its charter, and which we believe to be a sum at least equal to the fair market-value of the land so taken, .	33,636 00
Total investment for land (say 49 acres) and buildings which were standing on the same, .	$138,790 00
The rendering-house, including the chimney, tanks, driers and machinery, will cost, estimating for work yet to be done, about . .	111,000 00
The engine and boiler house, including five tubular boilers and a Brown engine of 75 horse-power, ...	18,000 00
The cattle slaughter-house, ...	55,000 00
The cattle barns and sheds, ...	8,000 00
The sheep slaughter-house, ...	22,000 00
The stables for horses, ...	10,000 00
Salaries, architect, insurance and miscellaneous expenses thus far, ...	8,000 00
Making a total of actual expenditure and liability of the corporation already incurred amounting to	$370,790 00

For its income to pay the interest on this investment the corporation looks to the rents it will receive from the leases of the slaughter-houses, and the profits it may be able to realize from the rendering-works. It will have facilities for rendering the tallow for the butchers, for which it will charge a fair rate, or it may purchase the rough tallow and manufacture and sell it on its own account. It will have the blood and refuse of the slaughter-houses, and will have as products from these sources a certain amount of tallow, soap-grease, glue-stock and dried blood, animal matter and bone. These three last are believed to be of great value as fertilizers, upon the demand for and selling-price of which the success of our experiment will largely depend.

The rendering-house is large enough for any demand that can be made upon it for many years to come. No further expenditure will be necessary at present for power. The boiler-house is designed for ten boilers. The corporation will be able, with its present facilities, to furnish heat, hot-water and steam for all the buildings now erected or contemplated, and all that will be required to do all the cattle and sheep slaughtering that is done in the vicinity of Boston. But the number of slaughter-houses must be at once increased. Probably not less than from seventy-five to a hundred thousand dollars ought to be expended on such buildings the coming year. The foundations of another block are already laid; but as these will be at once rentable, and will increase proportionately the supply of material for rendering, their erection cannot fail to be for the interest of the company. The company will also probably be under the necessity of building a number of dwelling-houses suitable for occupancy by its employés. The land of the company bounding on Market Street and Winship Avenue will afford a very desirable location for houses; and it is for the interest of all engaged in the business that they should be built speedily and that the rents should be equal to a reasonable interest on their cost, and no more.

It is obvious, therefore, that in order to meet the just requirements of the State Board of Health, the corporation has already incurred an expense far beyond what was anticipated by its charter, and that it must provide means for a much larger expenditure. Thus far the money over and above the capital subscribed has been all raised by the directors or stockholders. The stock is not yet fully subscribed for, and although it has been for some time offered to the public, is not in great demand, and perhaps it is too much to expect that it will be as long as the success of the enterprise shall remain a matter of experiment. It is very certain, however, that while the corporation may or may not realize a profit from its investment, every owner of land in Brighton or the portions of Cambridge, Newton, Brookline and Watertown near to Brighton, will derive an immediate and great benefit from the concentration of the business of slaughtering which the formation of the corporation is effecting. We have felt that such land-owners ought to aid us by subscribing to the stock of the

association, that as they certainly reap a profit from, they should be willing to share the risks of the undertaking. Thus far, however, with two or three exceptions, the subscriptions to the stock have come from those engaged in business connected with the markets; and judging from present appearances, the butchers and those associated with them will have to carry through the work from their own resources and with the aid of such sums as the property and credit of the association will enable it to borrow. We hope and believe that these resources will suffice. We certainly have something to show for every dollar expended, and the land originally purchased is probably worth to-day much more than it cost. Our location for the business proposed to be done is unsurpassed. When graded it will embrace a tract of forty-nine acres of level land, not wanted for first-class dwelling-houses, but yet dry and affording the best of foundations. Any vessel which can pass the draws can lie at our wharf. The track of the Boston and Albany Railroad runs for a long distance along our southern boundary. We have two unfailing sources for a supply of pure fresh water. On the opposite side of the stream the land is a marsh, and will not be wanted for dwellings for many years. If an abattoir can ever be established for Boston and its vicinity, it can be at the place you have designated for our association. In conclusion, I can truly say that thus far everything has been done thoroughly, for permanance, and with a determination to comply with every requirement of the Board of Health. Whatever the result may be to us pecuniarily (and the exhibit here made is sufficient to show that the corporation cannot expect for a long time to come to earn at best more than a moderate return from its outlay), in a sanitary point of view, success is already ensured. We expect long before the adjournment of the legislature to be able to show our works in practical operation.

Truly, your obedient servant,

JOHN N. MERIAM,
President B. S. and M. Association.

BRIGHTON, January 15, 1873.

HEALTH OF TOWNS.

HEALTH OF TOWNS.

[During the past year the circular letters of the Board have related to the subjects of sewerage and water-supply, and have been sent only to towns of four thousand inhabitants and upwards.

The following pages therefore refer chiefly to these subjects. The reader will, however, find other and valuable information from our correspondents concerning the causes of disease.]

Attleborough.—The water-supply is from wells, and is generally good. Some wells are too shallow; a few have been spoiled by the percolation of acidulated water from manufactories. A system of sewers is under consideration by the town, and will eventually be built.

Amherst.—The centre of the town is in need of an independent water-supply. Other parts of the town have good wells. There is great carelessness with regard to sink-drains and privies.

Amesbury is supplied with water from wells for the most part. Some families use rain-water, stored in cisterns. In some of the principal streets there are brick sewers. In other parts of the town the kitchen and sink wash are drained into the open street-gutter, or into hogsheads sunk in the earth, or thrown upon the ground.

Abington has good wells and no sewers. Fluid slops are, as a rule, carelessly thrown on the ground.

Boston.—The health report of the chief city of Massachusetts for 1872 is of an unfavorable character. The same neglect of the authorities to remove causes of disease, perfectly within their control, has continued, and their effects are seen in the extraordinary number of deaths. As a city increases, the mortality will inevitably increase more rapidly than the population, *unless the means of repressing disease keep pace with the city's growth.*

Boston has neglected such provisions, and is reaping the fruit of the neglect.

In addition to the usual causes of death, which gather intensity with every year's official negligence, Boston has had to meet an epidemic of small-pox, which is now sweeping over this and other countries with a virulence previously unknown. The effect of this unusual mortality from a special and temporary cause on the general mortality from all causes is worthy of

particular remark, and is commended to the attention of the fatalists who contend that all efforts to prolong human life are vain and useless, and that an epidemic diminishes the mortality of other forms of disease.

There died in Boston in 1871, 5,888 persons. There died in Boston in 1872, 8,089 persons. Small-pox destroyed 28 lives in 1871, and 738 lives in 1872. Reckoning the total mortality in each year, the increase in one year is 37 per cent. Excluding small-pox in both years, the increase in one year is 25 per cent.

The death-rate cannot be given because we do not know the present population. But every one will see that however great the increase may have been in the business of Boston, the number of persons resident within its territory can hardly have increased more than 5 per cent. in a single year, and probably not more than 3 per cent. We do not regret that the exact death-rate cannot be recorded, for the figures would be discreditable to the metropolis of New England.

Happily the sanitary interests of Boston are in a state of revolution. The old system (or rather want of system), of which each of the previous reports of this Board has freely spoken, has passed away, and a new management of health affairs has just now commenced. Public opinion, at last thoroughly aroused by the incapacity of the city health committee to deal with the epidemic of small-pox, has forced from a reluctant board of aldermen a portion of the powers which they possessed, and placed them in the hands of an independent board, consisting of three citizens appointed by the mayor and confirmed by the city councils. They are now just entering upon their important duties with the support and good wishes of all good citizens. They will need every encouragement from those who see the need of radical reforms, and we bespeak for them a helping hand and voice from all who have the future health and welfare of Boston at heart.

Blackstone.—"The water-supply is generally from wells; these are very often polluted by privies or sink-drains. There are some small reservoirs fed by springs, and one large reservoir supplies some fifty families from the Blackstone River, but this water is not generally used for drinking or cooking. There are some sewers of stone masonry and cement belonging to the Blackstone Manufacturing Company but none belonging to the town."

Beverly.—Our correspondent says, "Our water-supply is from Wenham Lake. The main pipes are of cement; most of the service-pipes are of galvanized iron. It seems to me that the State should institute some inquiries which would result in a satisfactory settlement of the question whether there is any danger in the use of such pipes. There seems to be a difference of opinion among those who ought to know. No cases of zinc-poisoning have come under my notice." Beverly has no sewers; with such abundant supply of water they are surely needed.

Barnstable.—"Water-supply from wells in some portions of the town. Many people have cisterns in the ground, cemented, and obtain their water-supply from the roofs of buildings. There are no sewers, and as a general rule our water-closets are nuisances. Slops are thrown everywhere, in cess-pools, pig-stys and on the ground. A few people in the larger villages have drains and closed vaults with stench-traps.

"Many cases of fever I have traced to the influence of some filthy hole around dwellings. We are however greatly favored by the nature of our soil which is a light, porous sand."

Brookline.—Water is supplied by wells for the most part, but also in parts of the town from Jamaica Pond. In a region near the line of the Hartford and Erie Railroad the springs are strongly impregnated with peroxide of manganese and oxide of iron. This water rapidly destroys lead-pipe and injures the health of those who depend on it. Our correspondent has several wells on his premises but uses by preference rain-water received in a cistern, which is divided by a partition of soft brick. The water is filtered in its passage through the brickwork.

There are two brooks (besides Muddy River) running through Brookline, which are practically sewers, but many of the foreigners living on their banks use the waters for culinary purposes. Parts of Brookline are well provided with sewers, many of which have been recently built and in the best manner. They discharge into Muddy River.*

Chicopee.—"There are wells at very many houses in this village, dug years ago, and almost wholly abandoned for the aqueduct water. Water is found almost anywhere at the depth of ten to fifteen feet, but it tastes brackish and *swampy*, much of the land now built upon having been originally a swampy pasture with alders and frog-ponds. The highest land above this village is a sand-plain, reached by an elevation from the river-level of more than a hundred feet, I think three-fourths of a mile or less from the river. In this sand wells are sunk by the aqueduct company, and water found by digging from three to ten feet, according to surface, the water, as I understand, being all on the same level. This cannot come from springs as the land is the highest for miles, but is probably held in an immense clay basin, and is therefore quite pure and good, but it is carried to the people in old logs, lead-pipes, iron-pipe, stone-pipe, &c., many of which have become decayed and brittle and call for such constant repairs that the water is kept stirred up and full of sediment much of the time. It has also for the last two or three years been kept 'shut off' during the warm months, to the great inconvenience and sometimes, in my opinion, to the injury of the health of the people. Nearly all summer no water was to be had after nine, P. M., till morning, to the great detriment in case of sickness of such as had no ice, as the taste became well-nigh insupportable after standing a few hours.

"Our main business street for commercial purposes has no sewer and no adequate drainage, and a large majority of the cellars abutting on this street are very often flooded with water. I have seen some being emptied with force-pump and hose into the streets. The Dwight Company own the land for a considerable distance between this street and the canal and Chicopee River, and I am informed are not willing to have the sewage fall into their canal, and very properly too in all probability, as they have thousands employed all day in its immediate vicinity. There should be a large, deep sewer the whole length of Exchange Street, ending on the bank of Connecticut River.

"At Chicopee Falls, another village in the town, of 3,000 inhabitants, the water-supply is better. The same remarks respecting sewage will apply to this as to the centre village."

* The difficulties which are likely to grow out of this disposition of sewage, with reference to the future growth of Boston westward, are clearly explained in a recent report of Mr. H. M. Wightman, assistant city engineer. It is another proof of the need of some comprehensive plan of drainage for the whole metropolitan district. [SECRETARY.]

Charlestown has excellent water from Mystic Pond. The people are however becoming anxious, and as we think with good reason, about the final effect of casting so much refuse into the sources of supply. The Charlestown sewers are reported to be in good condition. Our correspondent states that "there are tenement-houses on the streets bordering our city where the drainage is very poor, owing to the carelessness of the inhabitants in allowing the drains to be obstructed by solid refuse. The tide also seems to wash back the sewage and cause trouble."

Cambridge.—Our correspondent writes as follows:—

"The nuisance at East Cambridge, caused by the condition of Miller's River or Creek, is well known to the State Board of Health. Several sewers enter this river or creek and the sewage is imperfectly carried off by the tide-water, and the smell at low tide is horrible. The pork establishments on its borders add to the stench. The nuisance has become intolerable and must be abated in some way. The only feasible method of doing this seems to be by filling up the creek and constructing a trunk-sewer through it, so that the sewage may be discharged nearer the channel of Charles River.*

"I subjoin certain statistics, collected by Dr. H. O. Marcy, in relation to the health of the population in the vicinity of this nuisance.

"Population by wards, 1870:—

Ward 1,	6,909
" 2,	10,389
" 3,	9,178
" 4,	8,865
" 5,	4,311

"Whole number of deaths for five years in ward 1, 552; ward 2, 1,267; ward 3, 1,134; ward 4, 728; ward 5, 376. Total, 4,057.

"The number of inhabitants to one death, per annum, in the whole city, 48.80; Middlesex County, 49; wards 1, 62.66; 2, 41; 3, 40.45; 4, 60.90; 5, 56.

"The death-rate in wards 2 and 3 is greater than in wards 1, 4 and 5, by 20 per cent.

"Number of inhabitants to one death, per annum, in ward 1, 62.66; in ward 3, 40.45. The death-rate in ward 3 is greater than in ward 1 by 22 per cent.

"The population of wards 1, 4 and 5 in 1870 was 20,085; deaths in the wards named, 1,656. The population in wards 2 and 3 was 19,565; deaths in said wards, 2,401, showing an excess of deaths in wards 2 and 3, with a less population than wards 1, 4 and 5, of 745.

"Of the land in ward 1, 10 per cent. is marsh; ward 3, 60 to 75 per cent.

"The whole number of deaths from cholera infantum for the past five years in this city, 463; in ward 3, 133, or 35 per cent."

It will be seen that the mortality in wards 2 and 3 (which borders on Miller's River) is greater than in the other three wards combined.

Clinton.—"The Lancaster Mills supply about 150 families with water from the Nashua River, which is pumped into a reservoir on an eminence, and thence distributed to the tenements. The remainder of the town is supplied by wells. This water is generally 'hard,' containing chloride of sodium, car-

* The "Miller's River question" has been investigated by order of the legislature, and report made. See "General Report of the Board" in this volume. [SECRETARY.]

bonate of lime, and some in addition sulphate and sulphuret of iron. Most of these hard well-waters corrode lead-pipe, and are injurious to persons drinking them. I have never known of a case of lead-disease from river-water passing through lead-pipe. Lancaster Mills have sewers which convey away all the sink-wash, soap-suds, &c., which is emptied into the river below the mill. Their sewer is of brick. The liquid sewage of the rest of the town is deposited in cesspools."

Danvers.—The board of health of this town seems to be active and efficient in looking after the causes of disease, in establishing drainage, and promoting plans for a complete water-supply. Members of the medical profession are foremost in these good works.

Dedham.—The supply of water from wells is so unsatisfactory that many families rely upon rain-water cisterns Wells are subject to quicksands, and are often fouled by neighboring cesspools. Our correspondent hopes that a beautiful lake three miles from the town may supply the people with water at no distant day.

Fall River seems to be as yet but poorly provided with water and with sewers. The city has recently grown with great rapidity, and so crowded a population will evidently need large expenditures to provide for public health and safety. Extensive works for the conveyance of an ample supply of water are now in process of construction, and it is hoped they will be able to supply the city, in part at least, before the close of 1873.

Framingham.—Our correspondent reports more sickness in 1872, a year of unusual wetness, than in 1870 or 1871, years of comparative drought. In the last-named years the wells were low, and the supply of water for domestic use insufficient.

Trichina disease, which is one of rare occurrence in Massachusetts, or which is rarely recognized, has appeared in a family in Framingham since our last report.

The family of Mr. W. consists of himself, wife, a son of fifteen, a young child and a servant girl. Mr. W. killed a pig on the 2d of December, 1872. It had been raised by himself with care, fed largely with apples, and during the last six weeks of its life on Indian meal and water. It was about a year old and very fat. The family ate of the meat of this pig at four or five meals about December 18th to 20th in the form of salted (unsmoked) ham and sausages. The ham was thoroughly cooked. The sausages had been frozen and were *very slightly cooked, so that the heat had hardly penetrated the interior portions.* On Christmas day Mr. W., his wife and son of fifteen were all affected with swelling of the eyelids. This was soon followed by swelling of the whole face; a few

days later, swelling of the legs and feet, and violent pain of legs, arms, shoulders and back. Mr. W. had diarrhœa for a week. Mrs. W. was not affected in this way. Suspicions of poison were excited, and a piece of salted ham from the pig was sent to Dr. J. C. White, of Boston, for examination. The mystery was at once solved by the microscope. Dr. White discovered very numerous unencapsuled trichinæ in the muscle.

This family was visited by the Secretary of the State Board of Health, January 23d, 1873. Mr. White and his wife were still suffering a good deal of pain, but able to go about the house, and were daily improving. The boy had gone to school, still feeling somewhat stiff and sore, and complaining that he could not run. The servant girl had not been affected. She had tasted the sausage, but had eaten very little of it, and the presumption is, that the part she ate had been cooked enough to destroy the life of the trichinæ. The child had eaten no pork.

[A report of cases of trichina disease occurring in Lowell and Saxonville in 1870 will be found in second annual report of the State Board of Health.]

Fitchburg within a year has introduced water from an artificial basin of eleven acres, furnishing an excellent supply, both as regards quality and quantity. Our correspondent also writes as follows:—"During the last winter and spring we had some thirty-five cases of small-pox and varioloid. We also had epidemic measles last winter. But very little typhoid fever or dysentery for a year past, but a good deal of catarrhal fever during the past autumn. Two cases of miasmatic fever have been noted,—one caused by work on an obstructed drain, and another from carrying out, opening and burying a cask of rotten cucumbers on a hot morning in September. Both recovered under the use of quinine."

Great Barrington—This town is not properly drained, but could be by a little effort on the part of the citizens, as there is a fall of from twelve to twenty feet from the main street to the Housatonic River. In some instances large cesspools are made to receive contents of water-closets, &c., and will, in our correspondent's opinion, prove dangerous to health.

The town is supplied with water from a reservoir made by damming a stream in the mountain.

Gloucester is greatly in need of a supply of water, above suspicion, but our correspondent reports that recent ill-luck in the fishing-business will probably postpone for the present any costly improvements in this direction. There are very few towns in the State whose territory is so riddled

with privies and wells. Brooks leading to the docks and beach are used as sewers.

Grafton.—Our correspondent notes occasional instances of wells polluted by the close vicinity of sink-drains.

Haverhill.—Our correspondent writes that "A thorough system of drainage will soon be adopted by the city. The lower portions of Haverhill are as yet undrained, and are very wet, owing to a heavy clay deposit. Our water-supply comes from ponds lying near the city limits, but the upper portions are unprovided for. The water is generally of good quality."

Hingham.—Water-supply from wells unreliable. Rain-water cisterns are in some cases used.

Hyde Park now depends for its water-supply on wells, and also very generally on cisterns filled by rain falling on the roof. An independent supply from other sources will soon be needed by this growing town.

Hopkinton.—About one hundred families are now furnished with water from a spring near the centre of the town, but the supply is unsatisfactory in amount.

Holyoke.—This enterprising young city is mainly supplied with water from the Connecticut River, but a charter has been given to take water from two ponds within the township. The sewerage, now in process of construction, will be very complete.

Lynn.—This city seems to be quite aware of the need of a complete supply of pure water, and a corresponding system of sewers, to its future health and prosperity. The sources of water-supply which are really available for Lynn are numerous, and the difficulty is to choose between them. There are lakes of great purity and extent just around the city, and from some of them it is quite certain a safe and bountiful supply will be got. At present the water of Breed's Pond, to the amount of its capacity, 1,000,000 gallons daily, is distributed by about forty-five miles of street pipe. This is only about half of what is needed. There are, we think general reasons enough given in another part of this volume to make the people of Lynn hesitate before engaging to drink the water of Saugus River, which is strongly advocated as a source of supply by one of the parties into which the city is divided on the water question.

The wells of Lynn, which now furnish water to half its population, are confessedly impure.

A comprehensive plan of sewerage has been adopted, and all the principal business streets are already furnished with the means of disposing of every form of liquid waste. The sewage is discharged into the harbor, which is very shallow, and its flats much exposed by the receding tide. The final disposal of the contents of the sewers, so as to create no offence, will apparently be attended with difficulty. A plan of utilization, like that proposed by Mr. Ball for Worcester, would be well worth considering.

Lawrence.—"More attention has been paid during the past year to the improvement of the sanitary condition of the city, but as yet we have no satis-

factory system, or efficient board of health. An effort was made this year to secure a board, which should comprise medical men and others specially interested in sanitary reform, but it was not successful. An efficient board of health, with ample authority, would reduce the mortality of the city, in my opinion, very perceptibly, especially during the summer months. Lawrence, however, is improving in all respects, and when Boston sets us a good example in the composition and methods of its board of health we shall be very likely to copy it.

"Lawrence is in great need of an adequate water-supply. The supply is insufficient, except in the industrial establishments and their boarding-houses. It is thought that the only adequate supply can be obtained from the Merrimack River, which will involve an immense outlay, and the project is therefore strongly opposed by many. I presume that some plan will be adopted before many years to obviate the difficulties and overcome the objections."

Lawrence is partially supplied with sewers, and they are annually extended. The oldest sewer is built of stone-masonry, the others of brick and cement.

Marblehead.—Our correspondent reports the need of water-supply and of sewerage.

Marlborough is dependent on wells, and there is much dissatisfaction, but chiefly on account of the danger from fire.

Milford.—This town is becoming so compactly built up that a supply of water from without will soon be needed, not only for the fire department, but to avoid the danger from the corruption of wells by drains, cesspools and privies.

Newton.—This large town of many villages has various needs and conditions as regards water-supply and sewerage. Certain sections, as Newton Corner, Newtonville, West Newton and Newton Centre, would be willing perhaps to pay for a good water-supply, but the town is unwilling at present to incur the cost, although the question has already been much discussed, and must be in the future. Auburndale has springs from which water is conducted by pipes. Upper and Lower Falls have the river for all fire-purposes, and wells for domestic use. The well-water at Newton Corner has been proved to be impure, and is no doubt contaminated by the sewage of dwellings and stables. In one case, where analysis was made by Dr. J. R. Nichols, it was found to have 11.65 grains of solid contents to the gallon, of which 4.95 were of organic materials, and this was better water than most of the wells furnish, and more remote from defiling influences.

Newburyport is not satisfied with its water-supply from wells, and a good many families use filtered rain-water. The city is drained by a natural slope to the river, which receives liquid refuse by gutters and superficial conduits. Our correspondent reports the health of Newburyport to be remarkably good, and states that during the summer of 1872 they were exempt from mortality among children to a degree unusual in places of equal population.

New Bedford is supplied with water from Acushnet River, which is pumped to a reservoir at sufficient elevation to distribute it throughout the city.

Natick.—Our correspondent reports as follows: "Our water-supply for both domestic and fire purposes has been very poor during the past two

years. At the last March meeting the subject was discussed and preliminary steps taken to procure a better supply.

"There is no system of sewerage, but our principal village is so compactly built that great nuisance must soon result unless some extensive and general plan is adopted. Then will arise a very important question, Where shall our sewage be delivered? Our natural drainage is into Lake Cochituate, and how will this affect the purity of the Boston supply? At present it probably does not affect it. Still the probability of its doing so increases year by year with the growth of this village. Should there be any system adopted for a supply of water for this part of Natick, it must be by drawing the water from Lake Cochituate, and then returning it again in the waste-form to the lake. This would affect other interests than our own. The subject impresses me as one of great future importance." *

North Adams.—Water for this village is from a stream running down the northern slope of "Graylock Mountain," and is very pure. Since the introduction of this water wells in the village are dispensed with for the most part; they were in too close connection with privies and cesspools to be safe.

Peabody.—Our correspondent in this town describes the same stream referred to in letter from Salem (North River) at a higher point, where it is formed by the confluence of Goldthwaite's and Proctor's Brooks, as "the grand and only sewer in Peabody for the drainage of street-surface overflow, and of the various manufacturing establishments. Among them are print-works, a bleachery, many tanneries, and some morocco-dressing factories and glue-factories. It also drains two slaughter-houses, in one of which five thousand cattle and thirty thousand sheep are annually killed." A dam which existed on this stream in Peabody was happily removed two years ago, and the stream has been closed on all sides with plank, and the old pond-bed filled up solid. "This has wrought a great change in the sanitary condition of the town, for whilst the waters were dammed up, this pond-bed, which in summer was but slightly covered, was the receptacle of all the refuse from the establishments above named, and was a seething mass of corruption, a breeder of disease, and at all times an eyesore of the worst description. This state of things is done away with at this point, but still exists lower down at Frye's Mills."

Peabody is supplied with water of excellent quality from the pipes of the Salem and Danvers Aqueduct Company, and from other reservoirs, but there is a strong desire to have a still larger and more constant supply from the Wenham Lake Company.

Plymouth is supplied with water of great purity and in abundance, from a lake five miles distant.

Pittsfield.—"In its *water-supply* our town is particularly blessed, receiving from Ashby Lake, seven miles distant to the east, at a great elevation above the town, an unfailing supply of the purest spring-water. The supply is sufficient, even in the winter, when every faucet is kept constantly open to prevent freezing. The water of the lake is conveyed to a reservoir two miles down the mountain by a tumultuous brook, joined by other brooks on the way. From the reservoir the water previously filtered through gravel is brought to the town by iron pipes.

* The attention of the people of Boston is called to the above remarks of the late Dr. Lincoln, of Natick. [SECRETARY.]

"Since the introduction of the water, no epidemic, or fever (excepting the local one at Maplewood) has been known in Pittsfield, and the health of the town has in every way improved. The fact is a very striking one, and made more so by each year's observation, that the great majority of our cases of fever are outside of the Ashby water-supply.

"The present year the number of fever cases, although moderate, has been somewhat greater than usual, but scarcely one has come under my observation in any house supplied with the Ashby water.

"The fever at Coltsville was mentioned in my report of last year, and I can now add something to its history. The present season there have been, to my personal knowledge, seven cases of typhoid fever in that vicinity; and the indications are that there will yet be others. Among these one death has occurred. For several years fever has prevailed in that locality, and the reason why can hardly yet be said to be determined. The settlement consists of a dozen houses, clustered about a paper-mill, and very near the banks of a shallow and rapid stream, the ground rapidly rising on either hand. It is thus a shut-in locality, where the sun acts powerfully, and but little air is stirring. The soil is dry and sandy, the wells mostly old, some of them having been dug thirty years ago. There are two artesian wells, however, of great depth, for the mill and the workmen in the mill, and the occupants of the houses close by drink the "hard" water which these furnish. The man who died of fever this summer drank artesian-well water; but most of the sick used well-water. In one house was a boy very sick with typhoid. The house was very neat both in its interior and surroundings. The well, however, which is thirty years old, had been cleaned out, and a new pump had been put in, just a fortnight before the boy was taken sick, and I have little doubt the stirring-up process had contaminated the water. The soil is so porous in this vicinity that a rise in the river immediately affects some of the wells, and this would tend to allow surface-washings to find their way speedily into the wells. There is one family in which three cases of fever have successively occurred. In this case, the intolerable filthiness of the house and its occupants renders it unnecessary to suppose any more remote cause. The smell of the rooms is sickening, notwithstanding the neighbors have made an invasion with mop and soap.

"Adjoining Coltsville, and extending up the same river for three or four miles, lies the village of Dalton, with five paper and three woollen mills. The Dalton valley is narrow, though not quite as much shut in as Coltsville, and has for many years been a favorite haunt of typhoid fever. Now, it seems probable that some endemic cause exists in Dalton and Coltsville beyond the mere local, or, as we may say, *domiciliary* causes, which are about the same in all country towns. I think there is no doubt that this cause is the river, which, narrow and shallow, dammed at frequent intervals, receiving the waste and sewage of many factories, and flowing through a contracted valley, where the air is stagnant and the sun is hot, poisons the air in its vicinity, and adds a general cause to the many special causes of typhoid fever. It is true, that most of the factories are paper-mills, in which chloride of lime is used in large quantities for bleaching, and that much of this finds its way into the river; but the quantity is not sufficient to disinfect the whole river.

"The past summer has been characterized by unusual *heat* and *moisture;* and the general prevalence of summer diseases is as follows:—*Typhoid fever,* slightly increased; *dysentery,* none at all; *cholera morbus,* very severe, and

prevalent; *cholera infantum* and *infantile diarrhœa*, unusually prevalent, and exceedingly fatal.

"The number of deaths among children under two years of age has been very large, especially among the Irish and the bottle-fed. Each period of excessively hot weather with the cool days following, has been a period of fatality among infants.

"As yet, our town is but partly *sewered*. A three-feet brick sewer is carried through the principal business street, and a few other streets have eighteen-inch pipe of Scotch tile. These all empty into a four-feet brick sewer which empties just below the dam at Pomeroy's factory. Until last year, it emptied into the mill-pond, above the dam; and I think there has been a decrease in the amount of sickness in that vicinity since it was carried below the dam."

Rockport.—"Although the water used for drinking and cooking in this town is mainly from wells, and is generally good, there is one locality, embracing five houses, in which it is obtained from springs through lead pipes. As these pipes are kept constantly running, it has been thought that there was no danger of the water becoming contaminated so as to compromise the health of the families using it. Without committing myself to any opinion on the subject I present some facts which, if they do not point to the slow contaminating influence of lead, must be regarded as singular coincidences. These houses were built between thirty and forty years ago. Two of them have changed their inmates several times; the other three were built and occupied by the same families until last Christmas, when the head of one of the three families died. He had been extremely deaf, and totally blind from cataract for some years previous, and was seventy years old. His son, and only child, died of consumption twelve years since. His widow survives.

"In another of these houses, in a family of seven grown-up children, two are affected with amaurosis. In the third, the father, aged seventy-one, is very deaf; the mother has cataract. One of the five children died of chronic dysentery, two married young and left the homestead, and two have been long absent in California.

"No direct signs of lead-poisoning have ever appeared in any member of these families, yet that there should occur two instances of deafness, two of blindness, and two of amaurosis among nineteen persons below the age of seventy is sufficiently anomalous to excite inquiry as to the causes which have brought about such results. I submit these facts, hoping that through your extensive correspondence light may be thrown on this question."

Stoneham.—The water is from wells, and on the whole is unsatisfactory, both as regards quality and quantity. The sewage goes into a sluggish rivulet which passes through the village. The rivulet, or ditch, is uncovered. Drains are of the poorest description, made of stones rudely thrown together; they are too small, get choked up, and are almost useless.

Springfield.—Our correspondent gives much interesting information, which we quote in full:—

"The present water-supply of this city is inadequate. About one-half the city is supplied by wells or springs immediately adjoining the premises; the remainder of the city by the aqueduct company. This company has proved unequal to supplying the demands, and the whole matter of water-supply is

now in the hands of a board of commissioners, chosen by the people. This board are now actively engaged in this matter, and a bountiful and permanent supply will, undoubtedly, soon be furnished. An analysis of the aqueduct water and the water from five wells in different parts of the city gave the following results:—

General Quality of Water for City Use.

	Kind of organic matter.	Mineral matter.	Organic matter.	Total.	General quality of water.
Aqueduct Comp'y,	Objectionable,	1.64	1.22	2.86	Objectionable.
Well No. 1, . .	Bad, . .	14.83	3.08	2.86	Bad.
2, . .	Bad, . .	7.82	2.03	9.85	Bad.
3, . .	Objectionable,	9.38	2.66	12.04	Bad.
4, . .	Not bad, .	8.81	2.01	10.82	Bad.
5, .	Bad, . .	11.53	1.91	13.44	Bad.

"Much of the impurity in the wells was due to the proximity of drains, cesspools, &c., and general surface-drainage.

"The system of sewerage is inadequate and objectionable. The surface to be drained is, first, a broad plateau ten to twelve feet above the ordinary surface-water of the Connecticut River; next, an irregular plateau one-half mile distant from the plain, and reached by a well-defined ascent. The sewers empty directly into the river, and during high-water the sewer is submerged and the river-water flows in, damming up the sewer-water and soaking into cellars and lower portions of the plain.

"The sewerage from the ascent to the plateau is through sewers emptying directly into the sewers on the plain. The upper plateau itself is badly sewered, much of the drainage being through drain-pipe into cesspools, in close proximity to dwellings.

"With no general plan or system of drainage for the whole corporation, but only a care for the immediate and separate needs of different localities, the total result is a few well-made, well-laid sewers, running from the upper plateau, through a few of the principal streets, direct to the river, while the greater portion of the drainage is through the Town Brook, a crooked, shallow, sluggish-flowing stream, partly covered and partly open (dividing in the centre of the business portion of the city and emptying into the Connecticut by two mouths, one mile apart), slowly turning over and exposing to the sun in its course the material poured into it from house-drains and sewers and slowly bearing the putrefying mass to the river, save in high-water, when a return current floods many cellars and saturates the adjoining banks with the 'seeds of disease'; while in the portion of the city supplied with good sewers the whole atmosphere is tainted by the noxious gas which pours out from numerous sewer-wells, untrapped and communicating freely with the outer air. In fact, every precaution seems to be taken to prevent the foul air from going anywhere except among the dwellings of the citizens.

"In connection with the subject of town-drainage, I am personally much interested in the subject of house-drainage in this neighborhood, and am surprised at the ignorance of, and unbelief in the need of thorough ventilation of drains and soil-pipes. The general belief seems to be that a water-seal

one-half to one inch in depth is *all* that is needed to keep the sewer-gas from the interior of the building. No more fatal belief can be held, and the result is, drain-pipes, soil-pipes and waste-pipes so arranged that a slight extra pressure of sewer-gas forces the water-seal and distributes the poison all over the house. The water-seal, or trap, as generally used, will only resist a slight pressure, and thorough ventilation is a safe and reliable means of preventing undue strain.

"A common arrangement here is to carry the soil-pipe from the upper water-closet to the drain without ventilation, trusting entirely to the S trap below the closet to keep back the gas. A column of water three to four inches deep *might* hold it, but as generally arranged it is useless against an extra pressure of gas, and I have seen the gas escape in bubbles from the top of a water-seal, two inches in depth. If the soil-pipe were carried from the drain to the top of the house, opening above the upper level of all windows, and *only* the pipes from the water-closets, trapped as at present, allowed to enter it, the hygienic condition of our dwellings would certainly be much improved, and the present practice of ventilating our 'closets' all through our sleeping-rooms be done away with. Another objectionable practice is to allow the waste-pipes from bath-tubs and wash-basins to empty into the soil-pipe. The soil-pipe should be for 'excreta' alone, and another pipe, provided with a separate entrance into the drain, be used as a common waste-pipe;* otherwise you run the risk of ventilating your soil-pipe through the waste-pipes. In building a house, a flue devoted especially to ventilation can be carried up in the chimney. The objection to ventilating your drain simply by a gutter-pipe, as sometimes done, is that in a house built with a 'French roof' the pipe opens below the level of windows; and secondly, the gutters are performing their duty when they are most needed as ventilators, viz., during a rain-storm.

"That this is not simply theory I have proof in my own residence, both of a previous faulty arrangement and consequent unpleasantness and danger, and a successful remedy by a new arrangement as just described.

"During the first five months of this year (1872) scarlet fever prevailed in Springfield. There were 33 deaths from this cause in a mortality of 274 from all diseases. During the same period there were 48 deaths from consumption; a large proportion of the latter among the foreign population, who live in a low and damp portion of the city. The city clerk tells me that reported deaths from consumption are less numerous, proportionately, now than ten years ago, and that the diminution has been gradual during that period.

"During the autumn bilious and bilious remittent fevers have prevailed with moderate intensity. This form of fever is often confounded with typhoid in this neighborhood. The soil in the lower part of the city is the rich bottom-land of the Valley, and may readily be associated with bilious derangements as seen in a truly malarious district.† (Perhaps the malaria

* The reader will observe that this recommendation does not in all respects correspond with advice on the same subject on the twenty-fourth page of this volume. It is there supposed that free ventilation of a *single* conduit, into which all refuse fluids are received, is sufficient. [SECRETARY.]

† This occurrence of autumnal fevers of a remittent or periodic type in the Connecticut Valley, as noted by our correspondent, is confirmatory of opinions expressed in a paper on "the causes of typhoid fever" (Second Report of this Board), and also in another on "mill-dams and water-obstructions" (Third Report of this Board). [SECRETARY.]

about here is not intense enough to produce marked chill and fever.) A more complete and wide system of sewerage will no doubt do much to lessen the intensity and frequency of this disease.

"The too numerous shade-trees and their proximity to dwellings, especially of the better class, have a bad influence on health."

Salem.—"One of the most dangerous sources of infection in the Commonwealth is created by the low banks and flats along the 'North River.' On the upper part of this estuary are numerous tanneries. The washings from macerated hides find their way directly to the river. Numerous outhouses are built so that their deposits fall upon the open banks. Many private drains open into it. The carrion-like odor of the stream invites contributions of dead animals or whatever may emit foul smells, for here any individual stink would be lost in the general rankness. The river with sluggish current, at ebbing tide lets fall its disgusting burden along the flats, where under the summer sun it annoys and sickens many. We are filled with apprehensions when we think of this hot-bed for the multiplication and dissemination of the cholera poison, should any outbreak of this epidemic occur."

Southbridge.—The water-supply for domestic use is deficient, and poor in quality. The river running through the town from east to west is defiled by the waste of numerous factories. Our correspondent says, "A general law of the State is needed authorizing towns to take water from sources of purity and plenty without the liability to litigation with corporations which control the water-shed of the larger rivers. A law is also desirable which shall compel the utilization of the excrement dropped into the streams by the operations employed in the large mills, and forbid contamination of the water by drugs and chemicals, so largely used in printing, dyeing and bleaching."

Stoughton.—Our correspondent informs us that while the water-supply is generally good and satisfactory, there are many instances in which it is rendered so impure by the proximity of privies and stables, that recourse is had to neighboring wells more favorably situated

West Roxbury.—As population increases there is more and more complaint of wells, and also increasing need of sewers. Many citizens look for relief from these evils in annexation to Boston.

Webster is fortunate in having an intelligent physician on its board of health. This town has adopted a health code very similar to that of Wakefield, which has been distributed among its citizens. Webster needs both water-supply and sewerage, and we doubt not, with the attention which can be directed to these wants by its health authorities, it will in due time be provided with all which the public safety requires.

Watertown is dissatisfied with its wells, and is looking towards Charles River for a better supply of water.

Waltham has gone a step farther, and is hoping to be supplied from Charles River in July next. The wells of Waltham show evidence of contamination by sewage.

Wakefield.—This prosperous town is taking a leading part in sanitary reform. The chairman and secretary of the board of health of Wakefield

are physicians, and are doing a work which should, and we doubt not does, secure them the thanks of their townsmen. The public health and safety are not left in doubt through any man's carelessness or ignorance. The following code of regulations has been issued by this board, and we have reason to believe is strictly enforced. It has already been copied by several other towns, and may well serve as a guide for very general adoption, with such modifications as the peculiar circumstances of towns, as regards population, site, occupation of the people and similar local distinctions, may seem to require.

(Copy.)

BOARD OF HEALTH REGULATIONS.*

The board of health appointed by the town, hereby make and publish, as required by law, the following "Regulations for the Public Health and Safety":—

Prevention of Disease.—Privies.

Reg. 1.—No privy or water-closet not having a water-tight vault, or such vault with a water-tight drain, to convey the contents to a proper reservoir, shall be established within two rods of any well, spring or other source of water used for culinary purposes; and such reservoir shall be at least two rods from any such water source. Provided, however, that earth-privies or closets, where dry earth or ashes is daily added to the deposit vaults, in sufficient quantity to absorb all moisture, and the entire contents are removed weekly, may be so established.

Reg. 2.—No privy-vault shall open into any stream, ditch or drain, except common sewers, or in the manner specified in Reg. 1.

Reg. 3.—Within the limits bounded by Lawrence Street, north, Water Street, south, Railroad Street, west, and Vernon Street, east (including the houses on both sides of the said streets), no night-soil shall be removed from any premises until ten o'clock at night.

Parties removing night-soil outside the limits specified, are recommended to cover their loads with dry earth whenever removed by day.

Drains, etc.

Reg. 4.—No sewer-drain, not water-tight, shall pass within two rods of any well or other source of water used for culinary purposes.

Reg. 5.—No sewer-drain shall empty into any lake, pond or other source of water used for culinary purposes, within the limits of this town.

Reg. 6.—No house-offal, dead animals, or refuse of any kind shall be thrown upon the streets by any resident; and no butcher, fishmonger, or vendor of merchandise, shall leave any refuse upon the streets of this town.

Reg. 7.—All families are required to have a proper covered receptacle for swill and house-offal, and to cause the contents to be regularly removed as often, between the first day of June and the first day of September, as twice a week, and once a week at all other seasons.

It is recommended by the board, that wherever surface-drainage is used for the waters of sinks or cellars, that the soil be frequently renewed; and it is also earnestly recommended, that all cellars be thoroughly drained, when practicable.

* The Board shall make such regulations as it judges necessary for the public health and safety. * * * * Whoever violates any such regulation shall forfeit a sum not exceeding one hundred dollars. [*Ext. General Statutes, Chap.* 26, § 5.

Hogs, Goats, etc.

Reg. 8.—No hogs or goats shall be kept within the limits specified in Reg. 3, except in pens kept free from standing water, and regularly and freely disinfected; and no hogs shall be kept with 100 rods of any dwelling else where, except the pens be kept free from standing water.

The board will order the removal of such animals within the specified limits, in any case where they may appear to be prejudicial to the public health, safety or comfort.

Diseased Animals, Sale of Food, etc.

Reg. 9.—No animals affected with an infectious or contagious disease, shall be brought within the limits of this town. No diseased animal, or its flesh, shall be sold or offered for sale; and no decayed, diseased, or unfit meat, fish, vegetables, fruit or other article of food, shall be so sold or offered for sale.

Reg. 10.—No person shall sell, or offer for sale adulterated milk, or milk produced by animals improperly fed; and whoever is supplied with milk, which there is good reason to believe is adulterated or is so produced, shall at once submit the same, with the name of the seller, to the inspector of milk.

Slaughter-houses, etc.

Reg. 11.—No slaughter-house or abattoir shall be established or used as such within the limits specified in Reg. 3, and none elsewhere within the limits of the town, unless kept free from all obnoxious smells, and all offal be removed daily.

No melting or rendering-house shall be established or used as such, within the limits of the town, except by special permission and location of this board.

Reg. 12.—No manufacturing or other business, giving rise to obnoxious or injurious odors, shall be established or continued within town limits, except in such locations as this board shall assign, and all existing manufactories, stables, etc., shall use all means available to render themselves inodorous and non-objectionable.

Reg. 13.—All putrid or decaying animal and vegetable matter must be removed from all cellars and outbuildings, on or before June 1st, and if not buried, must be deposited at least fifteen rods from any highway.

Reg. 14.—No fish, slaughter-house offal, or other decaying animal matter, shall be left upon land for purposes of fertilization, without being ploughed in or otherwise rendered inoffensive.

Vaccination.

Reg. 16.—Every child must be vaccinated before *two years* of age. The board earnestly recommend that all children shall be vaccinated before *six months* of age, and that all persons be re-vaccinated as often as once in five years.

Reg. 16.—All persons above two years of age who have never been vaccinated must be vaccinated immediately.

Reg. 17.—All incorporated manufacturing companies in this town shall cause each new employé to be vaccinated on entrance, unless proof is furnished of successful vaccination within five years.

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Reg. 18.—The provisions of the 17th Regulation shall also apply to the keeper of the almshouse in reference to each new permanent occupant.

Reg. 19.—No person, teacher or scholar, shall become a member of any public school until vaccinated, unless furnishing to the school committee the certificate of a regular physician of this town that he or she has been successfully vaccinated within five years.

Reg. 20.—The school committee are required to demand such certificates before granting permits to scholars or appointments to teachers.

Restriction of Disease.

Reg. 21.—Any householder, in whose dwelling there shall break out a case of cholera, yellow fever or small-pox, shall immediately notify the board of health of the same, and, until instructions are received from the board, shall not permit any clothing, or other property that may have been exposed to infection, to be removed from the house, nor shall any occupant take up residence elsewhere without the consent of the board.

Reg. 22.—Any physician who may be called to a case of either of the diseases specified in the foregoing regulations, shall at once report such case to the board, and receive their instructions in regard thereto, and whenever there shall come under the observation of any physician such number of cases of scarlet fever, measles, typhoid fever, dysentery, or "spotted fever," so called, as in his opinion to justify the belief that a considerable epidemic thereof exists, he shall at once report the same to the board, with such suggestions in regard thereto as may seem to him expedient.

Reg. 23.—No person sick with any of the diseases specified in Reg. 21, shall be removed at any time except by permission and under direction of the board of health.

Reg. 24.—Persons affected with either of the diseases specified in Reg. 21, and all articles infected by the same, must be immediately separated from all persons liable to contract or communicate the disease, and none but nurses and physicians will be allowed access to persons sick with these diseases.

Reg. 25.—All vessels used by such patients must be emptied immediately after use, and cleansed with boiling-water.

Reg. 26.—Persons must not leave the premises until they, together with their clothing, etc., shall have been disinfected, and permission given by the board of health.

Reg. 27.—All bedding and personal clothing affected with contagion or infection, which can without injury, must be washed in boiling-water.

Reg. 28.—Infected feather-beds, pillows, and hair mattresses, must have their contents taken out and thoroughly fumigated, and their ticks washed in boiling-water. Infected straw and excelsior mattresses must have their contents removed and buried, and their ticks washed in boiling-water. Infected blankets, sheets, and pillow-cases, and all articles in contact with, or used by the patient, must be washed in boiling-water.

Reg. 29.—Personal clothing and bedding, particularly comforters which cannot be wet without injury, must be disinfected by baking or by fumigation, but no article must be burned without the direction of the board of health, and all disinfection and fumigation not specified in Regs. 27, 28 and 29, must be done by or under the direction of the board.

Reg. 30.—No person or article liable to propagate a dangerous disease shall be brought within the limits of this town, without the special consent and direction of the board; and whenever it shall appear to any person that

such person or article has been brought into the town, immediate notice thereof shall be given to the board, and, if such person or article remains within the town, the location thereof.

The Board earnestly bespeaks the coöperation of every individual in securing the desirable sanitary condition to promote which the foregoing regulations are framed.

All parties desiring night-soil removed may leave their orders with the secretary of the board.

All citizens are requested to notify the board of any existing nuisance or cause of injury to health. Per order of the board.

(Signed,) CHAS. JORDAN, M.D., *Chairman.*
AZEL AMES, Jr., M.D., *Secretary.*

WAKEFIELD, May 1, 1872.

Woburn.—The water-supply has been deficient, but pipes are now being laid from Horn Pond. This pond now receives a large proportion of the sewage of the town, directly and indirectly, and the inevitable effect of taking its waters for domestic use must be to remind the citizens of the urgent need of sewers to carry the sewage of the houses and the numerous tanneries to Mystic River below Medford. With such an arrangement, and a protection of its banks, Horn Pond can be kept pure forever, but unless measures are soon taken to prevent this defilement its bed will become a settling-basin for filth, and its waters will be unsafe to drink.

At several large leather manufactories in Woburn the tannery-waste is either filtered or its insoluble portions allowed to subside in reservoirs, from which it is subsequently removed to be used as a fertilizer. This plan is to be commended most certainly on sanitary grounds, but our readers will find in another part of this volume evidence enough to show that even when water so treated appears clear, it still contains soluble materials of a kind unfitting it to be added to any source used for the supply of drinking-water.

SMALL-POX IN MASSACHUSETTS DURING THIRTEEN MONTHS ENDING WITH FEBRUARY 1ST, 1873.

On the fourth page of the present volume will be found an Order passed by the House of Representatives, January 21st, 1873, directing the State Board af Health to report the number of cases of small-pox in the State in 1872 and the first month of 1873, the number then existing, and the supposed cause of the appearance of the disease in each town.

The required information was sent to the legislature on the 8th of February, 1873, and is here recorded, with the addition of returns from twelve towns making report after our reply to the Order was presented, and while this volume was in press.

One hundred and ninety-seven (197) cities and towns report cases of small-pox or of varioloid as follows :—

CITIES AND TOWNS.	Total Number of cases in Thirteen Months.	Number February 1, 1873.	Probable source of Infection.
Acton,	3	-	Boston.
Acushnet,	1	-	New Bedford.
Adams,	34	-	Paper-rags.
Agawam,	3	2	Unknown.
Amherst,	1	-	Unknown.
Andover,	3	-	Boston.
Arlington,	15	-	Unknown.
Ashburnham,	9	1	Athol and Boston.
Ashby,	1	-	Charlestown.
Ashland,	5	-	Boston.
Athol,	7	-	Boston and New York.
Attleborough,	14	7	Lynn, New York, Boston, Providence and Somerset.
Auburn,	2	-	Spencer.
Amesbury,	36	3	Boston.
Becket,	4	-	Canada.
Bedford,	2	-	Boston.
Bellingham,	9	-	Travelling.
Berlin,	1	-	Boston.
Billerica,	4	-	Boston.
Blackstone,	10	-	Paper-rags.
Bolton,	1	-	Boston.
Boston,	3,187	232	New York and Philadelphia.
Braintree,	12	5	Boston.
Bridgewater,	5	-	Boston.
Brighton,	8	2	Boston.
Brookfield,	11	-	Boston.
Brookline,	16	2	Boston.
Burlington,	1	1	Boston.
Cambridge,	237	22	Unknown.

Cities and Towns.	Total Number of cases in Thirteen Months.	Number February 1, 1873.	Probable source of Infection.
Canton,	4	–	Boston.
Carver,	9	1	Unknown.
Charlestown,	294	36	Boston.
Chatham,	1	–	Boston.
Chelmsford,	2	–	Lowell.
Chelsea,	144	11	Boston.
Chicopee,	11	3	New York and Boston.
Cohasset,	3	–	Boston.
Cummington,	19	–	Paper-rags.
Dalton,	6	–	Lee.
Danvers,	3	1	Boston and Marblehead.
Dartmouth,	21	–	Boston.
Dedham,	8	1	Boston.
Deerfield,	1	–	Greenfield.
Dennis,	2	–	Boston.
Dighton,	17	–	Rags.
Dover,	5	–	Boston.
Duxbury,	1	–	Boston.
Douglas,	3	–	Boston.
East Bridgewater,	2	–	Boston.
Easthampton,	5	–	Buffalo.
Easton,	2	1	Boston.
Edgartown,	7	–	Boston.
Egremont,	1	–	New York.
Enfield,	2	–	Boston.
Essex,	3	–	Gloucester.
Everett,	11	3	Boston and Charlestown.
Fairhaven,	3	–	Boston and Dartmouth.
Fall River,	20	–	Boston.
Falmouth,	1	–	Boston.
Foxborough,	7	1	Boston.
Franklin,	6	–	Boston.
Fitchburg,	24	1	Paper-rags and Boston.
Framingham,	11	1	Unknown.
Georgetown,	2	1	Boston.
Gloucester,	88	17	Boston and Philadelphia.
Great Barrington,	1	–	Unknown.
Greenfield,	1	–	Montague.
Groton,	3	–	Boston and Manchester.
Groveland,	1	1	Haverhill.
Hanover,	1	–	Boston.
Harwich,	1	–	Boston.
Haverhill,	12	2	Amesbury.
Hingham,	5	1	Boston.
Holbrook,	1	–	Boston.
Holliston,	11	–	Boston.
Holyoke,	32	–	Paper-rags.
Hopkinton,	1	–	Milford.
Hull,	4	–	Unknown.
Huntington,	3	–	Paper-rags.
Hyde Park,	7	1	Boston.
Ipswich,	3	–	Salem and Boston.
Kingston,	1	–	Boston.
Lakeville,	3	–	Boston.
Lancaster,	1	–	Canada.

Cities and Towns.	Total Number of cases in Thirteen Months.	Number February 1, 1873.	Probable source of Infection.
Lawrence,	37	6	Provincetown.
Lee,	14	1	Rags.
Leicester,	1	-	Southbridge.
Lenox,	4	-	Poughkeepsie, N. Y.
Leominster,	1	-	Boston.
Lexington,	13	3	Boston.
Lincoln,	1	-	Concord.
Littleton,	1	-	Boston.
Lowell,	17	-	Boston.
Lynn,	92	16	Boston.
Lynnfield,	1	-	Unknown.
Malden,	39	2	Boston.
Manchester,	1	1	Boston.
Marblehead,	35	5	Boston.
Marlborough,	12	6	Boston.
Marshfield,	1	-	Boston.
Mashpee,	1	-	Martha's Vineyard.
Mattapoisett,	1	-	Boston.
Medford,	14	2	Boston.
Medway,	29	-	Worcester and Milford.
Melrose,	12	1	Travelling.
Methuen,	2	1	Boston.
Middleborough,	8	-	Philadelphia and Boston.
Middlefield,	3	-	Springfield.
Milford,	12	-	Boston and Charlestown.
Millbury,	5	-	Graniteville, R. I.
Milton,	5	-	New York and Boston.
Montague,	2	-	Boston and Greenfield.
Montgomery,	6	-	Rags.
Nantucket,	1	-	Savannah.
Natick,	45	2	Boston.
Needham,	12	2	Unknown.
New Bedford,	13	-	Philadelphia, Boston, Bridgewater and Dartmouth.
Newburyport,	19	3	Boston.
Newton,	19	1	Boston.
Norfolk,	3	2	Boston.
North Andover,	1	-	Boston.
Norwood,	1	-	Boston.
Northborough,	1	-	Boston.
North Bridgewater,	15	6	Boston.
North Brookfield,	9	-	Boston and Barre.
Northampton,	9	1	New York.
North Reading,	1	-	Boston.
Norton,	8	8	Boston.
Orleans,	2	-	Boston.
Palmer,	1	-	Boston.
Peabody,	30	16	Boston.
Pembroke,	2	1	Abington and Boston.
Pepperell,	1	-	Travelling.
Pittsfield,	2	-	Unknown.
Plymouth,	15	2	Boston and Philadelphia.
Plympton,	11	-	Boston.
Princeton,	5	-	Boston.
Provincetown,	24	1	Boston and Philadelphia.
Quincy,	25	-	Boston.
Randolph,	4	1	Boston.
Raynham,	1	-	Boston.

Cities and Towns.	Total Number of cases in Thirteen Months.	Number February 1, 1873.	Probable source of Infection.
Reading,	2	-	Boston.
Revere,	8	-	Boston.
Rockport,	2	-	Boston.
Rehoboth,	1	-	Providence.
Salem,	65	8	Chicago and Boston.
Salisbury,	2	-	Newburyport.
Sandisfield,	1	-	Unknown.
Sandwich,	1	-	Boston.
Saugus,	7	-	Boston.
Scituate,	2	-	Boston.
Seekonk,	2	1	Providence.
Sherborn,	10	-	Boston.
Shirley,	1	1	Charlestown.
Somerset,	3	-	Unknown.
Somerville,	61	2	Boston, Cambridge and Charlestown.
South Hadley,	8	-	Holyoke.
Southborough,	1	-	Boston.
Springfield,	44	12	Canada, New Haven.
Stoneham,	14	1	Boston.
Stow,	2	-	Concord.
Sturbridge,	1	-	Boston.
Sudbury,	1	-	Unknown.
Swampscott,	2	-	Boston.
South Scituate,	3	-	Boston.
Taunton,	12	-	Boston.
Tisbury,	7	-	Chilmark, Boston.
Topsfield,	2	-	Boston,
Truro,	2	-	Charlestown, Boston.
Upton,	1	-	Savannah.
Wakefield,	14	4	Boston.
Wales,	2	1	Springfield.
Walpole,	8	3	Boston, Cambridge, Abington.
Ware,	9	-	Boston, Canada.
Wareham,	3	-	Fall River, Plympton.
Warren,	1	-	Boston.
Watertown,	10	-	Boston.
Wayland,	3	-	Boston.
Webster,	1	1	Unknown.
Wellfleet,	2	-	Boston.
Westborough,	7	-	Chicago, Framingham, Cambridge.
West Boylston,	1	-	Rags.
West Brookfield,	2	-	Unknown.
Westfield.	8	-	Hartford.
Weston,	4	-	Boston.
Westport,	27	7	Boston.
West Roxbury,	10	1	Boston.
West Springfield,	12	4	Rags.
Whately,	1	-	New York.
Williamsburg,	2	-	Boston.
Williamstown,	1	-	Concord, N. H.
Winchendon,	4	-	Boston.
Winchester,	10	1	Boston, Charlestown.
Winthrop,	8	-	Boston.
Woburn,	14	2	Cambridge, Boston.
Worcester,	24	2	Boston.
Waltham,	17	1	Emigrant vessel, Boston, and other towns.
Totals,	5,606	502	

One hundred and twenty (120) towns report that no cases of small-pox or varioloid have occurred. They are as follows :—

Alford.
Ashfield.
Ayer.

Barre.
Belchertown.
Belmont.
Berkley.
Bernardston.
Blandford.
Boxborough.
Boxford.
Boylston.
Bradford.
Brimfield.
Buckland.

Chesterfield.
Carlisle.
Charlemont.
Charlton.
Cheshire.
Chester.
Chilmark.
Colrain.
Conway.
Clinton.

Dana.
Dracut.
Dudley.
Dunstable.

Eastham.
Erving.

Freetown.

Gardner.
Gill.
Goshen.
Gosnold.
Grafton.
Granville.
Greenwich.

Heath.
Hadley.
Halifax.
Hamilton.
Hanson.
Hardwick.
Harvard.
Hatfield.
Hinsdale.
Holden.
Holland.
Hubbardston.
Hudson.

Lanesborough.
Leyden.
Longmeadow.
Lunenburg.

Mansfield.
Marion.
Maynard.
Medfield.
Mendon.
Middleton.
Monroe.
Monson.
Monterey.

New Ashford.
New Braintree.
New Marlborough.
New Salem.
Newbury.
Northbridge.
Northfield.

Oakham.
Orange.
Otis.
Oxford.

Paxton.
Pelham.
Peru.
Petersham.
Phillipston.
Plainfield.
Prescott.

Richmond.
Rochester.

Rowe.
Rowley.
Royalston.

Sharon.
Sheffield.
Shrewsbury.
Shutesbury.
Southbridge.
Southwick.
Spencer.
Stockbridge.
Sunderland.
Sutton.
Swanzey.

Templeton.
Tewksbury.
Tolland.
Townsend.

Tyngsborough.
Tyringham.

Uxbridge.

Warwick.
Washington.
Wendell.
Wenham.
West Bridgewater.
Westhampton.
Westminster.
West Newbury.
West Stockbridge.
Wilbraham.
Windsor.
Worthington.
Wrentham.

Yarmouth.

Twenty-five (25) towns have made no report. They are as follows:—

Abington.

Barnstable.
Beverly.
Brewster.

Clarksburg.
Concord.

Florida.

Gay Head.
Granby.

Hancock.
Hawley.

Leverett.

Ludlow.

Mount Washington.

Nahant.

Russell.
Rutland.

Savoy.
Shelburne.
Southampton.
Sterling.
Stoughton.

Westford.
Weymouth.
Wilmington.